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MOTIVATIONAL, BEHAVIORAL AND PSYCHOLOGICAL IMPLICATIONS OF ELECTRONIC MONITORING OF WORKER PERFORMANCE

Prepared for the Office of Technology Assessment
United States Congress

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PREFACE

Workplace electronic monitoring of employee performance is becoming more widespread, and with this increased application a number of important issues have come forth. Some deal with personal privacy considerations, while others center on the potential influences on worker stress and health. Sides have been drawn with unions and employee advocacy groups arguing against the use of electronic performance monitoring and going as far as recommending legislation to prohibit such use, and employers and their associations maintaining that electronic monitoring is vital to doing business and is a management right under federal labor legislation. This last contention by management has spurred congressional interest in changing labor laws, such as the National Labor Relations Act, to redefine labor and management responsibilities and rights. Advocates claim that such drastic action is required to provide the necessary legislation foundation for new organizational structures that will be needed in the next decade to deal with the wide ranging technological changes that will tranform the workplace, forcing new roles for labor and management, and "fuzzying" the lines of responsibility between the two groups. At the heart of this issue is electronic monitoring which provides opportunities to share information at various levels of an organization or to limit such sharing, and which reduces the requirements for direct human supervision thereby influencing the organizational structure dramatically. Because of its control role in technological change and personal privacy issues, electronic monitoring will be one of the first arenas in which efforts to change federal legislation on privacy and labor laws will take place. Such attempts must take into consideration the significance of electronic monitoring for improving working conditions and job design which may be eroded by technological advances and at the same time needed production improvements which can maintain the competitive advantage of U.S. products. Often these considerations are seen at odds, but they are not mutually exclusive or contradictory concepts and can be integrated to provide benefits to both labor and management. Such integration can be achieved by establishing monitoring systems that provide for more employee participation and control over work processes and which are coupled with employee motivation programs that reward participation, performance and commitment. Such systems can provide meaningful and satisfying feedback to employees, better means for employee evaluation, and production process information necessary to effectively manage production resources.

It is important to note that current electronic monitoring systems do not incorporate necessary features that will improve job design to benefit employees, and therefore the experience gained from these systems has little benefit in defining future directions and needs. Currently, there is no research evidence that demonstrates that electronic monitoring increases individual worker production, total workplace productivity, enhances the ability to manage and control workers, or improves the evaluation of worker performance. On-the-contrary, current electronic monitoring systems are so limited in their capabilities that they have fueled the objections of worker advocacy groups to electronic monitoring of worker performance. These systems rely primarily on second-by-second counts of the quantity of worker output without any consideration of the quality of the product, differences in providing specific products that change performance requirements and exceptional circumstances that throw-off timetables. Reliance on the number of units per hour puts inordinate emphasis on speed and can increase work pressure which is stressful, diminish job satisfaction, and decrease worker pride. Such systems are doomed to failure in the long run as they build "sweat-shops" full of unhappy employees who frequently move from employer to employer.

Those few electronic monitoring systems that do examine quality as well as quantity typically do the measurements in such an objectionable, "sneaky" way that the approach acts as a demotivator to workers rather than as a source of helpful information. Unannounced eavesdropping on telephone solicitations or monitoring the number of corrections made in a typed document are examples of current systems. A major concern in devising new electronic monitoring systems is ensuring that the information gathered represents the full gamut of employee performance including quantity, quality, service and initiative. Current systems do not gather all of this information and technological and worker evaluation advances are needed to be able to address all of them. But even if they can be measured, such as with the quality examples above, if the information is not applied in an appropriate way, then it will be harmful to workers and the production process. It is often said that today's electronic monitoring systems are not "evil", but the way in which they can be abused is "evil." Future systems that monitor more explicit information have the potential to be "more evil" than current systems if they are abused.

Because good experiences in using electronic monitoring are lacking, it is not possible to define explicitly how the future systems should be designed. Principles of job design and performance evaluation can be used to guide their development, but it will be through experiences in their use that refinements and redirection will occur. Such efforts should be undertaken on an experimental basis so that principles can be developed for building future systems. Congress, industry, and labor need to work together to test the efficacy of new concepts in electronic monitoring. Such efforts will serve as an important element in building America's future industries and providing satisfying and healthful jobs.

This report will look at various elements of electronic monitoring that are significant for employee behavior, performance, motivation, satisfaction, stress, and health. Its purpose is to highlight various aspects of each element that can contribute to good or to bad electronic monitoring from a behavioral psychological perspective. The paper does not provide definitive answers for the design of electronic monitoring systems because of the lack of experimental data needed for such formulations. However, it does give guidance on how to approach the design of such systems and what to watch out for. While it specifies significant policy considerations that can be addressed by Congress, it is clear that mutual cooperation between labor and management in trying out new approaches to electronic monitoring will be paramount if such systems are to be used successfully. This may require some changes in the nature and structure of work, but such changes will occur anyway with the introduction of new technology. The opportunity exists to tie technology and job design together in a proactive way and electronic monitoring can be an important element in this endeavor.

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ELECTRONIC MONITORING OF EMPLOYEE WORK PERFORMANCE

INTRODUCTION

This report examines the psychological, behavioral and performance influences of electronic monitoring of employees at work. Such monitoring is becoming more widespread (OTA, 1985) and is of concern because of its implications for worker privacy, stress, health and behavior, and for industry's ability to effectively control work and production activities. Concern has centered on office employees, for instance telephone operators and airline reservations clerks, who have their productivity monitored continuously by a computer and are exposed to eavesdropping to ensure that their style of interaction with customers is satisfactory. However, monitoring is not limited to such office work, industrial applications in blue collar assembly work are becoming more prevalent. Assembly workers have been assigned their own bar code (signature) that can be read by an optical scanner similar to those used at the grocery check-out. With this technology, factory managers can track individual output continuously, as well as, responsibility for defective parts in returned products. Current computer technology provides the capability to monitor work continuously if it can be quantified. Since the industrial revolution, economists (Smith, 1776), engineers (Babbage, 1832; Taylor, 1911; Gilbreth, 1914; Gant, 1919) and psychologists (Cattel, [see Poffenberger, 1947]; James, 1890; Munsterberg, 1913; Scott, 1911) have endeavored to develop better and better techniques to improve production through job analysis and quantification, the use of technology and economic rewards. They have developed sophisticated approaches for applying the latest technology to measure worker motions, behaviors and

~~output.~~ They have also constructed checklists and survey forms to examine worker motives, satisfaction and distress. These tools have been applied to the development of electronic monitoring systems, but, as this paper will demonstrate more needs to be done.

To understand the significance of monitoring of worker performance it is usefull to briefly review highlights of representative theories of workplace design.

The development of modern work design commenced with the economic theory of Adam Smith and the engineering applications of Charles Babbage at the time of the organization of the factory systems, about 1800. Babbage (1832) clearly anticipated that machines were more than devices and that combining them to achieve specific tasks could increase productivity. This trend toward work specialization was extended by Scientific Management of Frederick Taylor (1911) and Time and Motion Study of the Gilbreths (1914). The Scientific Management School aimed to discover the best method of work by analyzing and measuring work according to scientific methods and principles (Taylor, 1911). The extreme specialization of work under Taylor's principles gave managers the opportunity for more control over the work process. Through highly hierarchical work organizations, continuing feedback on the production process was given to management which was helpful in decision making about elements of production. According to Taylor this management philosophy was essential for efficient production and maximum profit. Frank and Lilian Gilbreth later refined Taylor's ideas. Their objective was to study work methods in terms of their simple component parts in the light of human abilitites and limitations. They took Taylor's concept of the separation of "planning" and "doing" to its extreme logical conclusion which was very specialized and fragmented task. Thus, they developed new methods of work observation known as Time and Motion Study (Gilbreth, 1914).

Taylor's theory was further modified by Henry Gantt (1919) who improved the bonus system to make it more acceptable to workers. However, the basic assumption of this incentive system still maintained that people were motivated primarily by money. In order to determine bonuses workers' performance was recorded by using a "Gantt Chart". The Gantt Chart (proposed in 1917) represents the oldest, simplest, and most widely used modern method for scheduling and planning various activities.

Taylor, Gilbreths and Gantt are at the origins of operations management which today includes such areas as inventory control, project scheduling, quality assurance, and work measurement techniques.

In a different vein organizational psychology practitioners (Munsterberg, 1913; Cattell, [see Poffenberg, 1947]; Scott, 1911) developed theoretical bases for evaluating and monitoring worker performance from management's perspective. This approach examined individual worker differences, skills and aptitudes in work to best match the worker to the tasks to be accomplished. However, while industrial engineers assumed that workers were motivated only by money, organizational psychologists provided more complex motivation theories including social considerations, individual needs and motives and workplace design considerations. In his book The Human Side of Enterprise Douglas McGregor (1960) contrasts the conventional, directive theory X philosophy of management -- followed by traditional industrial engineering theories -- with the humanistic Theory Y postition reflected by most organizational psychology theories. Central to Theory Y is the notion that management should recognize the employee's social and intellectual needs as well as financial considerations, and try to arrange jobs such that satisfy higher-level self fulfillment. This was postulated to lead to stronger commitment and contributions to the company. In that sense management should provide a structure for worker control and direction of their own work activities.

Like McGregor, Rensis Likert (1961) showed the importance of human resources management. However, unlike McGregor, Likert highlighted organizational design perspectives. According to him, the good interaction between managers and employees often was lost because of excessive management. Thus he proposed to cut out middle-management. This would require more information flow between top management and workers, in essence more feedback.

Taylor's Scientific Management created fragmented jobs. The Human Relations movement, McGregor and others attempted to counteract negative side effects of this approach, and their theories evolved into the job enlargement movement. Job enlargement focused primarily on putting more variety into the job by having more tasks of a similar nature. In the 1960's, the job design movement focus move to job enrichment which increased job content in terms of decision making, responsibility and control of tasks. The driving force behind the job enrichment movement was Frederick Herzberg (1966). According to him, there are three main components: (1) potential to develop skills and abilities, (2) the job must have built-in rewarding characteristics and (3) workers must be rewarded for performance. He proposed that people are motivated by internal factors and not external factors such as money (Motivation-Hygiene Theory; Herzberg, 1966). Job characteristics which address "motivators" and enrich a job were: direct feedback, client relationships, new learning, self-scheduling, unique expertise, control over resources, direct communication and personal accountability (Herzberg, 1974). Hackman and Oldham (1976) also presented evidence that there were a number of separable job attributes that interacted to improve worker performance, motivation, and satisfaction and to decrease absenteeism and turnover. These job characteristics were: skill variety, task identity, task significance, autonomy, and feedback (Hackman et al, 1975). Unlike Herzberg, Hackman and Oldham assume that this theory does not work for everybody since the psychological needs of people differ. Thus for persons with low achievement potential the theory did not work. Hackman and Oldham provided specific psychometric tools to diagnose jobs and to display workers for whom the theory would work best. This approach provided an opportunity to measure current level of performance, motivation, satisfaction, and job characteristics.

The trend in both engineering psychology and business is toward theories that characterize specific work elements such as technology, tasks and work organization and particular worker attributes that can be best fit together to provide the system for production. These are elaborations of Babbage, Taylor and McGregor and assume the importance of accurate information about worker performance to effectively guide the production process.

These theories have demonstrated that managers need to know (1) the performance level of employees and machines, (2) the status of the production process, and (3) the disposition of materials, machinery and human resources for effective, efficient production and maximum profit. The theories have also shown that workers need to know about their own performance as well as management's motives and rewards for the most effective performance. Current theory of production emphasizes flexibility in the production process, just-in-time application of resources, and the use of technology to produce a more stable, predictable production system. This theory requires that human performance be monitored in a similar way that machinery status is checked so that managers can exert maximum control over the entire work system including the human resources. It is being applied in all types of workplaces from steel mills to banks to the Post Office. It has been proposed that this approach to production is necessary for the United States to achieve a competitive advantage in world markets.

Alternative theories of production deal with creating the proper work environment and job design for high employee motivation that will ensure high level, quality performance. These theories emphasize the importance of worker efforts in the emerging high technology production processes, and particularly in the ever growing service industries. They argue that technology alone will not give us an international competitive advantage, but that a hard working, highly motivated, dedicated workforce is also a key ingredient for such an advantage. They point to the Japanese production system as an example where the workforce and technology go hand-in-hand to provide efficiency. These theories, like the technology oriented ones also stress the importance of monitoring employee performance for effective control of the production process. They differ in the application of the information collected; the technology based theories emphasizing its use in management control, while the job design theories emphasize its usefulness to employees in their efforts to control the work process.

These two approaches to the collection and use of performance information at work define important areas of consideration that need to be examined in determining the influences of workplace electronic monitoring and worker productivity, behavior, stress and health. For it is through appropriate application of performance monitoring that both increased production and higher quality of working life can be achieved. In this regard the following issues are important outcomes of monitoring that impact worker behavior.

These areas include (1) performance feedback, (2) goal-setting, (3) incentive systems, and (4) performance appraisal. This report will first examine each of these areas to define their significance in influencing worker behavior and attitudes. Next an overview of occupational stress considerations related to electronic monitoring will be presented followed by interviews of workers affected by electronic monitoring. Finally, a set of policy recommendations will be developed concerning the application of electronic monitoring at the workplace.

This report will not examine the characteristics or capabilities of various monitoring technologies. Such an examination has been undertaken by others in different reports (Westin et al, 1985). It is sufficient to say that employees in jobs that can be quantified using job analysis techniques can be monitored on a second by second basis with current technology in unobtrusive ways such that they do not even know if or when they are being monitored. Some systems are more apparent such as in the bar coding of products, while others are not as apparent such as telephone eavesdropping or keystroke monitoring.

The information used in this report was obtained by undertaking a thorough review of the literature in the social sciences, education and engineering topics for the general areas of interest (feedback, goal setting, incentives, performance evaluation, monitoring). Computerized literature searches were conducted using Psych Abstracts, ERIC, INSPECT and COMPINDEX for the time periods 1960 to present. In addition, several popular business and engineering journals were scanned by graduate students from 1984 to present volumes to identify current material that might not be in these literature data bases. Besides the literature review, data was collected from convenient samples of employees who are electronically monitored using a semi-structured interview format. A portion of the interviews were conducted face to face while the remainder were conducted over the telephone. Interviews took approximately 35 to 40 minutes to complete. (Appendix 1 illustrates the semi-structured interview format and content).

FEEDBACK

The role of feedback in performance has been studied at many diverse levels from sensory feedback and skilled motor response to knowledge of results and attitudinal reactions (Thorndike, 1905; Smith & Smith, 1966; Ammons, 1956; Bilodeau & Bilodeau, 1961). What is clear at all of these various levels of human response is that people want to know about their performance and in fact will endeavor to seek out such knowledge when it is absent. As Nadler (1977) stated "People are constantly searching for information to help them make decisions and correct errors, to give them direction, and to confirm their beliefs." In fact when feedback about working issues is absent, employees will actively seek it. Thus, individuals experiencing a high degree of contextual uncertainty, role ambiguity, high job involvement or low tenure on the job have reportedly been more active in seeking feedback within their environment (Ashford & Cummings, 1985).

Feedback is important at the most basic levels of response to guide the employee to the most appropriate actions. The more immediate the feedback and the better that it defines the results of the employee's action, the greater the control that the employee can exert over the skilled action being undertaken (Smith & Smith, 1966). Thus, when the data entry clerk inputs information by striking the keyboard there are various levels of direct, continuous feedback that occur, such as the force feedback from the keyboard and the displaying of the characters struck on the video screen. When such direct feedback is absent, like the absence of the pictorial display on a key-to-tape input device, then employees are more uncertain about their performance, are unable to detect and correct errors, and generally perform worse then when the feedback is present.

A second level of feedback is called knowledge of results and it generally is not continuous but is received after completion of performance, such as assembling a part or completing the input on an insurance form. At this time the employee can sense something about the quality of the product completed. But this is only an internal knowledge of results. Another level of knowledge of results occurs when the product is evaluated against some external comparison standard and the results are fed back to the employee. "You have produced 10% over the production goal today," or "Your output had 2% errors." This feedback provides general direction to the worker about future output.

There are a number of basic principles that concern the application of output to provide the best possible employee performance and attitude. These principles have been established for the various levels of feedback and for individual versus group feedback. An examination of these principles demonstrates many similarities across the various feedback levels and also helps to define the most effective ways to apply feedback to enhance employee performance, satisfaction and reduce stress.

In dealing with motor skills Ammons (1956) and Bilodeau & Bilodeau (1961) have defined considerations for enhanced performance and learning. In general, knowledge of performance provides information that can be used to modify behavior, for motivation to maintain or change performance and as intrinsic and extrinsic rewards that influence behavior. Essentially feedback or knowledge of results serves to reinforce habits, serves as cues to evoke established patterns of response (habits), or provides the motivation for performance and/or learning. For all practical purposes, sensory feedback of actions must be immediate for proper performance, while knowledge of results can be delayed to the most appropriate time (as when a work cycle is completed).

Seven basic tenants for applying knowledge of results to provide the best levels of performance and learning are:

1. The more specific the knowledge of results the more rapid the improvement and the higher the level of performance.
2. The longer the delay in giving the knowledge of results the less effective it is in affecting performance.
3. When knowledge of results is decreased, performance will drop.
4. Knowledge of results influences motivation, typically by increasing motivation to perform, but sometimes causing the opposite effect.
5. For all practical purposes the employee always has some knowledge about his/her performance and knowledge of results either reinforces that belief or demonstrates where the belief is wrong.
6. Knowledge of results provides cues for proper behavior.
7. Supervisory instructions can alter the employees response to the feedback received.

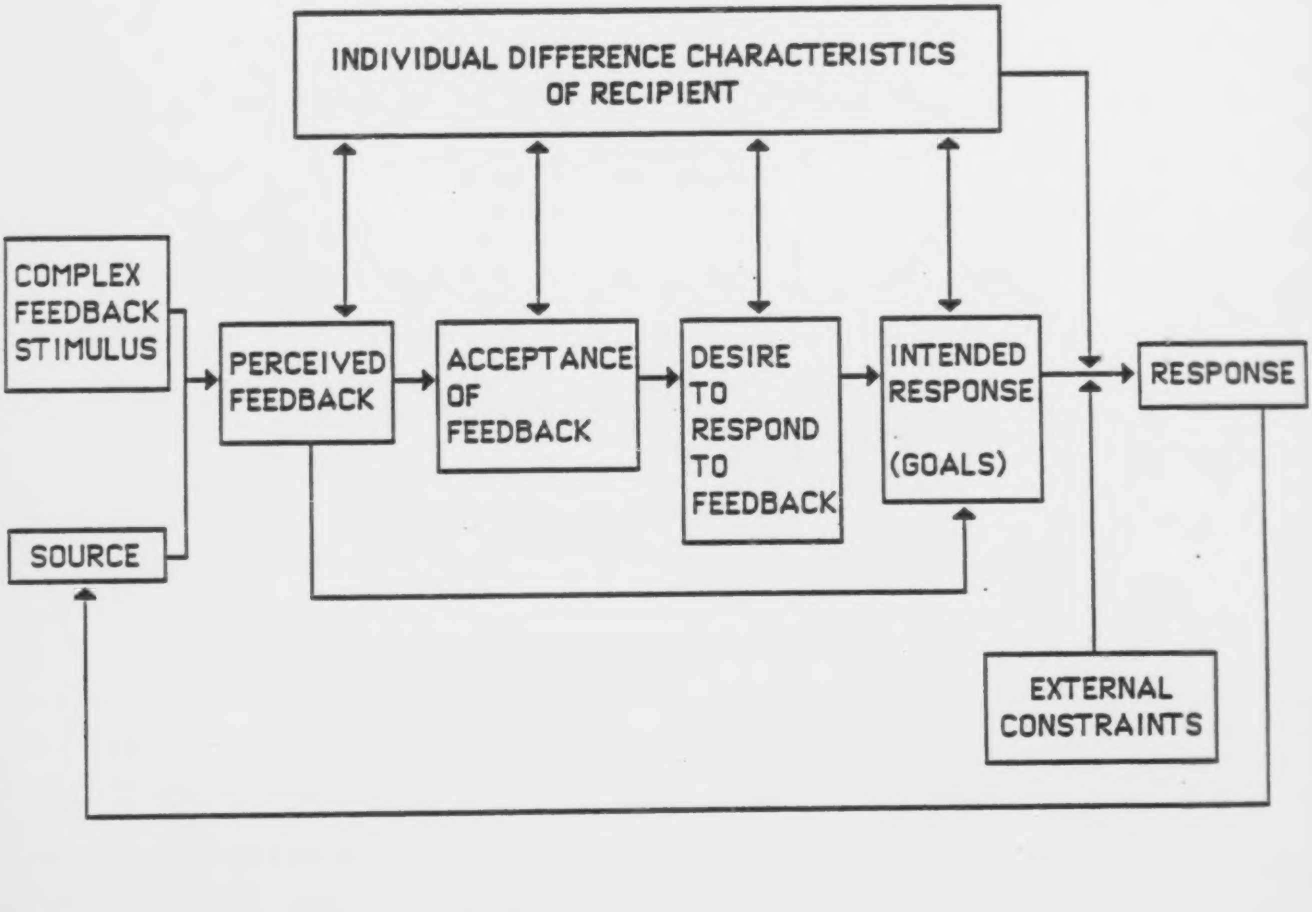
When we move to higher order feedback about job conditions and performance, a different set of considerations emerges, but with similarities to the skills level knowledge of results findings. To understand the role of higher order feedback in employee motivation and its relationship to worker performance, behavior, and stress reactions it is useful to examine a model proposed by Ilgen and colleagues (1979). Figure 1 illustrates the various elements of the model. There are important considerations in examining the feedback process and employee monitoring that are highlighted by the model. For instance, the employee's perception of the source of the feedback will influence the acceptance of the feedback, the behavioral and performance responses, and whether the feedback is stressful or not. For a highly regarded and credible source, the feedback will have more significant effects. In a similar vein, the message of the feedback will also have an influence. Thus, the perception of the accuracy of the feedback, the fairness and the medium (received from the supervisor or displayed on the video screen) all influence the acceptance of the feedback and its influences on responses(s). There are also characteristics of the receiver that will have an impact such as job tenure, frame of mind, current mood, and health status.

A range of theorists have proposed why higher order feedback about performance and working conditions is important for workers, and aspects of such feedback that determine its effectiveness (Nadler, 1977; Ilgen et al, 1979; Ashford & Cummings, 1983). Nadler (1977) suggests that individuals act and organizations function primarily on the basis of the information they receive; that people are constantly searching for information to help them make decisions and correct errors, to give them direction and to confirm their beliefs. Organizations are set-up to gather and process environmental data or internal data and getting the information from one person or group to another that can act on the information. Thus, information (feedback) has an important influence on the behavior of individuals and organizations and is a powerful tool for change. Information produces the impetus for change by providing for evaluation (comparison, direction setting) and rewards

FIGURE 1

MODEL OF THE EFFECTS OF FEEDBACK ON RECIPIENTS

Taken from Ilgen et al (1979)


INDIVIDUAL DIFFERENCE CHARACTERISTICS OF RECIPIENT
COMPLEX FEEDBACK STIMULUS
SOURCE
PERCEIVED FEEDBACK
ACCEPTANCE OF FEEDBACK
DESIRE TO RESPOND TO FEEDBACK
INTENDED RESPONSE (GOALS)
RESPONSE
EXTERNAL CONSTRAINTS

(punishments).

Feedback is an effective modifier of behavior if it is seen as a valued commodity by the recipient. It takes on value to the individual when it is effective (relevant, understandable, accurate, useful) and when it is necessary. It becomes necessary when the employee is in an ambiguous situation or uncertain of how to respond. New situations without familiar cues, situations that are overloaded with cues, contradictory situations where direction is needed or uncertain situations due to information inadequacy all need feedback to help direct response. Employees also seek feedback if they are not sure of the appropriateness of their own behavior or if their behavior is being evaluated such that rewards/punishments could ensue. In essence feedback is used to resolve feelings of ambiguity or uncertainty.

At the same time feedback of performance can create feelings of anxiety, frustration and lowered self esteem. Since feedback fulfills an error correction function as well as a performance appraisal function, it can indicate to employees that they are not doing their job as good as they would like to, or even as good as the company would like them to. This can create stress, even when it reduces the stress associated with uncertainty and ambiguity. Therefore, feedback is a two edged sword in addressing job design considerations for stress.

Research into the effectiveness of feedback in influencing human performance has primarily been laboratory based and designed to test theory rather than absolute levels of improvement produced by use of feedback. In addition, many different forms of feedback under widely varying conditions have been tested with very little consistency in the approach taken. Thus, it is difficult to provide absolute statements about the extent of improvement in performance that can be achieved through the use of performance feedback to workers. As will be discussed later many considerations such as the timing of the feedback, the accuracy in portraying performance, the various types of information such as quantity, quality, errors and corrections all have important influences on how people will respond. Most research studies on feedback only report statistical differences between feedback and no-feedback conditions and do not report absolute levels of subject performance. For those few studies for which absolute information is available, it appears that feedback can produce improvements of 3% to 15% under varying performance requirements with different tasks (Warm et al, 1972; Manzer, 1935; Church & Camp, 1965; Hundal, 1969; McCormack et al, 1962 & 1963; Matsui et al, 1983).

Based on the literature there are specific tenants that can be derived concerning higher order feedback about performance.

1. The feedback must be relevant and have value to the employee.
2. The feedback must be understandable and explicit (specific).
3. The feedback must be trusted (accurate, verifiable, from a good source)
4. The feedback should be positive for best results.
5. Feedback from one's self is more accepted than feedback from another source. Feedback from a machine is more accepted than that from another person.
6. Employees will actively seek feedback when they feel the need due to uncertainty, ambiguity or evaluative situations.

In summarizing the issue of feedback it is clear that there are some similarities between the basic perceptual/motor human performance feedback and the higher order feedback used to make judgments, set goals and motivate behavior. Feedback is a basic element of a self regulating system that is used to influence the output (performance, behavior, production, reward). Feedback has intrinsic qualities that motivate personal performance but that can also bring about feelings of stress. For the best possible performance, feedback should be frequent, positive, and valued by the recipient. It should provide cues and direction toward the desired goals. Feedback is the element that allows the steersman to successfully navigate the boat over the rapids. Thus, it is quite clear that monitoring of workers can be an important aspect of proper steerage, for without monitoring there would be only limited feedback to the employee. Monitoring provides for stuctured, consistent feedback that is equivalent for all employees. Without monitoring it is likely that only the most astute employees would be able to estimate their own performance. But monitoring must be established within the framework of providing the most appropriate and effective feedback to the employee; feedback that allows for direction, error correction and learning; feedback that is positive, motivational and rewarding; feedback that is useful, functional, valued, and allows for enhanced performance; feedback that helps to establish the necessary goals to work effectively. Such feedback has to be fed back to the employee but not necessarily to supervision for good performance. In fact, to protect employees from supervisory intimidation and to ensure positive use of individual feedback, it may be appropriate to aggregate individual monitoring results together to be fed back to management.

In this later regard, feedback serves a significant role in the setting of employee goals. Such action is a major element in monitoring since two primary purposes of monitoring are to establish standards of performance and to motivate employees to meet these standards. Therefore, a discussion of feedback and monitoring is not complete without an examination of feedback and goal setting.

GOAL SETTING

Just as feedback about performance can clearly be established as a critical element in promoting superior employee productivity, so too is goal setting. Proponents of goal setting have linked it to performance feedback as the one-two punch that can knock-out poor employee performance (Locke, 1968; Latham & Yukl, 1975). They argue that knowledge alone is not a sufficient condition for effective performance, but that goals are necessary to establish evaluation criteria and motivation to perform at high levels. In terms of employee performance monitoring, goal setting can be linked in three ways. First, monitoring provides the information base on which to develop and set performance standards (goals). Secondly, monitoring provides information about how successfully employees are meeting the standards. Finally, goal setting provides the targets of performance that motivate employees to achieve.

Goals are the object or aim of activity. They are what an individual is trying to accomplish, e.g. the quota, standard, work norm, task, objective or deadline. The basic assumption of goal setting theory is that goals serve as regulators of human action. However, one-to-one correspondence between goals and action cannot be assumed since people make errors, may lack the skills and/or abilities to attain the goals, have various conflicts in obtaining goals (increased incentive pay versus reduced health), or may lack organizational support (adequate resourses, organizational policies).

The goal may be implicit and largely unspecified quantitatively or qualitatively, or it may be quite explicit and detailed through the use of targets, standards and quotas. Specific goals have been found to result in better performance than no goals or general goals such as "do your best" (Locke et al, 1981; Latham & Yukl, 1975). Monitoring can provide information about performance output and quality on which specific goals can be set and which gives employees details about how they are reaching the goals. Although a specific goal is expected to improve performance over the level produced by no goal or a general goal, the impact of goal specificity on employee satisfaction and attitudes is mixed (Steers & Porter, 1974). On the one hand, a specific goal may help an employee to reduce the situation's uncertainty and ambiguity. On the other hand, a very specific goal that allows for less freedom and makes the situation less flexible may be stressful.

The precise nature of the relationship between goals and behavior is influenced by the effects of feedback, incentives and rewards, participation in setting the goals, commitment to the goals and individual personality. All in all, goal refers to attaining a specific standard of proficiency on a task, usually within a specified time frame and given specific conditions and constraints.

The purpose of goal setting is to provide direction toward a standard of performance. Goal setting achieves this by directing the attention and action of the employee toward the desired organizational outcomes. Thus, goal setting can be used to focus in on specific elements of performance that need to be enhanced which provides specific direction, but also can provide general direction on the level of desired production. A number of research studies indicate that goal setting is more effective in the presence of feedback or knowledge of results about performance (Locke, 1967; Kim & Hamner, 1976; Erez, 1977; for a review see Locke et al, 1981). Such feedback can provide information on how successfully the employee is meeting goals and serves as the impetus to change behavior to improve productivity. The feedback also provides an indicator of the reasonableness of the goal. If the employee is working at near top capacity and skill, and still is not within reach of the goal, then the employee has the basis for reexamining the goal.

This last point is important because Locke (1967) and Hamner & Harnett (1975) among many others indicate that it is more effective for management to set hard goals than easy ones (for a review of literature on goal difficulty, see Locke et al, 1981). Employees perform at higher levels under hard goals, but such high performance is achieved only if the employees have the skills and abilities as well as the physical resources to achieve the hard goals. When given hard goals, employees modify the work pace to increase output. Such an increase in work pace has the potential to be stressful if individual capacities are over extended. Salvendy (1981) points out that when standards of performance are externally established (by the company) that under conditions of high workload and fast work pace, these systems are similar to machine-paced work which has been shown to be quite stressful and detrimental to employee physical and mental health. In this regard some studies of goal setting demonstrate that employees set higher goals and work more productively when they participate in goal setting or when they set their own goals rather than using management established goals.

The relationship between goal setting and improved work performance is much clearer than is the case for feedback. While many of the studies are similarly laboratory exercises, there are also field experiences that allow for a more accurate determination of potential productivity influences. Latham and Yukl (1975) report that 10 of 11 studies in organizations using goal setting support its effectiveness in improving worker performance. Locke et al (1981) in reviewing various studies of goal setting demonstrate a 90 percent success rate in using goal setting to improve worker performance.

However, an important consideration is that goal setting is often used along with other work motivators such as feedback, incentives and worker participation. Thus, the most significant influences appear to be associated with the effective blending of goal setting with those of other factors. With this in mind it can be shown that goal setting has produced improvements in subject performance from 6 percent to 43 percent (Umstot et al, 1976; White et al, 1977; Locke, 1968; Latham & Yukl, 1975).

A number of factors influence the effectiveness of goal setting on employee performance. The personal abilities and skills of the employee will determine his/her ability to meet the standards that are established. Being able to meet the standards acts as a motivator to continue to perform well, while inability to meet the standards may motivate better performance but may also demotivate the worker and reduce effort and performance and cause stress. Personal motivation also affects the influence of goals on performance. If the employee is demotivated by other job factors such as repetitive work, then the influence of standards of performance will be less. Personality also plays a role in that persons who are not highly motivated to begin with may not respond well to imposed standards of performance. Finally, it appears that job tenure influences the effects of goals such that the more established employees respond better than newer employees.

The importance of employee participation in goal setting is clear. Early studies (Coch & French, 1948; French et al, 1966) in industrial settings have demonstrated higher goals and superior performance when employees have a role in setting their standards of output. More recent research on management by objectives (MBO) extends this important consideration (Drucker, 1954; McGregor, 1957; Odiorne, 1965). MBO is an approach to planning and performance appraisal that establishes employee goals and relates employee performance to organizational goals. It provides for manager/subordinate interaction and communication and through establishing goals, feedback and objective evaluation, stimulates employee motivation. Research on MBO indicates that after employees set standards that cannot be achieved, once they have worked they receive feedback that tells them they cannot meet the goal, the feedback can serve as the basis of redirecting their efforts and revising the standards. This is an active process that has shown to be extremely successful in blue collar, sales and managerial jobs for increasing productivity. It works because the employees are in control of their own performance as long as the standards they set are within the corporate goals. This assures highly motivated workers with positive feelings towards the company and their supervisors. Often goals are set too high and need to be revised. In the participative environment this is achieved with relative ease due to the interactive nature of the process. When goals (standards) are imposed by the company without worker input, inability to achieve the goals can produce stress. This often leads to conflicts between workers and management.

In summary, goal setting and standards development is a natural outcome of employee monitoring. Monitoring can provide employees with feedback that gives them an objective basis to evaluate their own performance, as well as, any standards that are set. Employees perform better when goal setting is used. Increased effectiveness is obtained from goal setting when: (1) employees participate in establishing their own goals, (2) hard goals are set, but are within the individual's capabilities and are accepted by the individuals, (3) goals are specific, and (4) goal setting provides for increased supervisory/employee interaction.

While goal setting can be effectively used to increase worker performance, it does not necessarily increase worker satisfaction (Umstot et al, 1976). In fact, care has to be taken that goal setting does not create increased stress for workers due to increased job pressure. An example of this is the use of goal setting with semi-autonomous work groups in a Volvo production plant that brought about increased workload that was unhealthy and stressful for some of the workers, even though production increased (Ostberg, 1982).

An important aspect of goal setting is the establishment of standards of performance that can be used to evaluate employees and reward them. The use of incentive systems to reward performance above standard levels is an established industrial method for increasing worker production. The advent of electronic monitoring can potentiate an increased use of this approach due to the availability of individual performance information. The next section will examine the effects of incentive systems on employee performance and behavior.

INCENTIVES

Since the initial efforts of Frederick Taylor (1911) to motivate employees with incentives, their use in American industry has steadily grown. An underlying consideration in the application of incentives for work performance is that employee efforts can be measured and quantified. Thus, a central aspect of incentive applications is the analysis of jobs to determine standard methods of performing work and to establish output standards. A second element is the establishment of a process that can track employee performance -- that is performance monitoring. The comparison of employee output to established standards (performance evaluation) then serves as the basis for the payment of incentives. These incentives serve as feedback to the employee about his/her performance and provide the motivation for employee goal setting. Thus, incentive systems contain all of the control aspects of employee monitoring examined in this paper, feedback, goal-setting, performance evaluation and performance monitoring.

In the distant past, employee performance was evaluated by looking at the number of finished products, the number of machine cycles or the number of letters typed. These outputs represented a complete task cycle and often were examined on a week-by-week or day-by-day basis. Emphasis was placed on quantity of output rather than quality. While this is still true today, as technology has improved, the ability to track worker performance on a continuous, second-by-second basis has become a possibility. Such a capability develops greater management control of the work system so that bottlenecks or breakdowns can be identified or shifts in production emphasis can be implemented at a moments notice. In addition, new technology provides the capability to stamp an identifier or signature on finished parts or products that can be traced for quality control and remedial action. Hence, with electronic monitoring, quality as well as quantity can be evaluated in the incentive/rewards process. This introduces a whole new approach to the reward system and to how employees respond to the system.

An understanding of how incentive systems influence employee behavior and production can shed some light on the possible impact of electronic monitoring of employee performance. Frederick Taylor's (1911) belief was that paying workers for each element of work completed (piece-rate payments) would enhance output by providing the financial opportunity for the worker to better himself in life. This belief in using contingent rewards to enhance behavior has support in the behavioral science literature in operant behavior theory, learning theory and expectancy theory. In brief, these theories state that people will engage in behaviors that they expect will be beneficial to them and which provide them rewards for performing well. This approach is based on the belief that external reinforcement can increase desired behaviors. These theories are in contrast to those that stress internal rewards which are sources of motivation and satisfaction to the person.

That incentive plans are entrenched in American industry as a way of dealing with worker production is reflected in a survey of U.S. and Canadian industries (Rice, 1977). This survey of 1500 companies, showed that 44 percent reported using wage incentives. For the factory respondents the percentage was 51%. In this same survey 89% of the respondents reported using some form of work measurement to develop work standards. Various types of incentive plans were used with standard hourly add-ons the most popular, followed by piece-work, and sharing plans. Forty-six percent of the performance standards were established by time study of specific jobs, while 23% were by standard data systems and 12% by predetermined time standards. Three fourths of the companies reported changing production standards when work methods or materials changed, 2/3 when employee performance was low due to a tight standard, and 1/2 when performance was high due to a loose standard. Only 1/4 of the companies indicated that unions could initiate revisions of standards and 3% said employees could initiate such revisions. As for reported benefits of the incentive systems, 95% believed that it improved direct labor productivity, while only 43% believe it improved non-direct labor productivity; 61% believed it improved direct labor morale, 28% non-direct labor morale; 59% supervisory effectiveness of direct labor, 27% non-direct labor supervisory effectiveness; and 25% improved direct labor quality, 3% improved non-direct labor quality.

This survey demonstrates significant differences in industry attitudes towards the effectiveness of incentive pay systems between factory and non-factory employees. The widespread use of work measurement methods, performance standards and incentives in factories indicates a firm commitment to the principles of scientific management as espoused by Frederick Taylor. The addition of electronic/computerized methods to enhance the application of work measurement (McDermott, 1984) will add to their application in non-factory environments, since these methods provide simple and structured approaches for work measurement and employee evaluation.

Some important considerations in the use of incentive pay need to be examined in light of this possibility.

Rothe (1960) has indicated that performance increases observed in the installation of incentive pay systems may be due as much to the improved work design because of work evaluation and measurement methods than the incentives themselves. In fact, Rothe (1978) has demonstrated that workers paid under individual incentives as well as those under group incentives show highly variable production output when they are observed over a long time period such as weeks or months. This suggest that rewards for production are not the only influences on employee production behavior in incentive pay work systems. Dar-El & Young (1977) suggest that workers on incentive pay systems often predetermine their earnings and decide beforehand how much they are going to produce. This is especially true when new work standards are set due to new job tasks. As workers learn to do the tasks and they improve their abilities as well as learn tricks in doing tasks their output should increase. Typically what increases is their idle time rather than production level. Some theorists feel this may be due to work group pressure to keep the standard at the current level or to worker fears that management will raise the standard if they perform too high. Whatever, the answer, the external incentive only has an effect up to a certain level of performance and then the effect is lessened.

Cammann & Lawler (1977) and Opsahl & Dunnette (1966) have suggested a number of considerations for the proper application of incentive systems for enhanced employee performance to occur. First, the rewards have to be of value to the recipient. Second, the rewards have to be clearly tied to performance. The employee has to recognize that good performance of a specific task will bring a specific reward. Third, the standards of reward have to be fair, and the employee has to believe he/she can achieve the reward. Fourth, the incentives must be positive. Fifth, the employee needs feedback about the rewards received and their performance. Sixth, the employee works harder if he/she participates in setting the standards of performance. Seventh, individual incentives appear to be more effective than group incentives in most instances. Actually the effectiveness of individual versus group incentives in terms of performance depends on the requirements of the tasks facing the group such as the level of coordination. Eighth, repetitive, boring, disliked work tasks are less susceptible to influences by incentives.

It is essential that performance standards be "perceived" as equitable (fair for everyone) and that employees feel trust for management. Salvendy (1976) revamped what the workers perceived as an unfair production standard that affected their incentive wage. His time and motion evaluation relaxed some of the requirements, which brought about substantial improvement in production above the previously believed to be unfair standard. It also brought about a decrease in union grievances, absenteeism and turnover and higher profits. Even though this study was successful, it has to be understood that incentive pay schemes are not typically established to increase satisfaction. In fact, often the opposite is true (Schwab, 1974).

In summary, incentive pay systems require that worker performance monitoring be undertaken to establish standards of performance and to determine pay-offs for performance. Monitoring can be a benefit to workers in these systems as it provides an objective data base for making accurate judgments about proper standards and equitable rewards. Incentive pay schemes do not enhance worker satisfaction and may contribute to "Taylorization" of jobs. Electronic monitoring and performance contingent reward schemes may also promote the simplification of jobs for easier measurement of performance. Thus, the use of such schemes can lead to worker stress.

PERFORMANCE APPRAISAL

Evaluating the performance of employees is a central aspect of organizational strategies for determining their compensation. Performance appraisal is a widespread approach that looks at employee performance over an extended period of time (quarterly, semi-annually, annually) and assesses a variety of employee achievements and behaviors that are felt to be of importance to the continued productivity of the organization. This process is tied closely to goal setting since success at achieving global goals is a primary aspect evaluated in a performance appraisal. Likewise, the appraisal process is tied to feedback since a main purpose is to inform the individual of how their performance and behavior are viewed by the organization, and to establish whether performance and behavior need to be changed.

Monitoring of employee performance is a more continuous process within more restricted time frames than performance appraisal. Currently, the relationship between the two processes is fuzzy because of the substantial difference in their time lines. However, one important reason for monitoring is to be able to evaluate employee performance to be able to change behavior as necessary which is also an important aspect of performance appraisal. Since this use of monitoring is quite new, it makes sense to look at performance appraisal, which has a long history of application, to see what the factors are that influence employee behavior, attitudes and satisfaction with the performance evaluation process.

The following quote from Landy & Farr (1980) succinctly defines the uses and current state of performance rating. "The measurement of performance in industrial settings has occupied the attention of psychologists for 50 years. Performance description and prediction plays an important role in all personnel decisions. Criteria are necessary for validation studies and training evaluation; indices of effectiveness or relative worth are necessary for administrative decision making with respect to current employees; performance-related information is necessary for feedback and employee counseling; there is even some indication that the process of performance evaluation may function as a reward and be capable of inducing feelings of satisfaction in some employees (Landy et al, 1978).

Unfortunately, realizing the importance of performance measurement and actually measuring performance accurately are two different matters. In some ideal sense, complete performance measurement would include the combination of objective, personnel, and judgmental indices (Landy & Trumbo, in press). Unfortunately, it is difficult to obtain objective indices of performance for many job titles. In addition, personnel information is applicable to a small portion of the employee population in any organization (e.g., 5% of the employees may have 100% of the accidents, less than 8% of the employees may have more than one unexcused absence per year, tardiness records are not well kept, etc...). Consequently, most individuals concerned with performance measurement depend on judgmental indices of one type or another. In spite of the widespread use of judgmental indices of performance, there has been a constant dissatisfaction with these measures on the part of both researcher and practitioner."

That managers and employees are unhappy with the performance appraisal process is a universal situation, one of profound concern to organizations. Because of the very important purposes of performance appraisal, it is vital for organizational effectiveness that this process be acceptable to managers and employees. Examining the problems with this process may provide clues to the implications of electronic monitoring in employee performance and the pitfalls to be avoided in using monitoring in employee performance rating or appraisal systems.

One of the main weaknesses of performance appraisal is the subjective nature of various aspects of the process such as what gets rated, how the ratings are obtained, who does the ratings, how the ratings are presented to the employee and when the ratings are given. All of these elements have aspects that can be influenced by biases or conditions that are not relevant to performance, such as being rated by a supervisor who has never done the job being rated, or conducting the ratings annually which may have no relationship to the timing or schedule of the job accomplishments. Many attempts have been undertaken to reduce the subjective nature of the evaluation process including: (1) developing standardized performance rating scales, (2) establishing goals of performance to be met during the evaluation time frame, (3) training evaluators so that they do a better job of appraisal and feedback, and (4) using objective indicators of performance.

Even with these improvements, satisfaction with performance appraisal is low. A major problem area is that employees have a hard time understanding how they can be evaluated for an entire year using a one or two page checklist, even though it might contain objective indicators of productivity. In their eyes this approach fails to take account of individual daily contributions, special efforts, instances of staying late to help out or pitching in when special deadlines had to be met. Thus, the time frame is not tied to specific task performance characteristics and provides only a global assessment which misses important specifics. The abbreviated nature of the review, the time frame and the use of standardized scales provides an "impersonal" impression. This, combined with the potential biases of the supervisor that are reflected in the subjective nature of the evaluation, often leads to employees viewing performance appraisal as a meaningless and distasteful process to be endured once a year.

This leads to an important question. If the performance appraisal process is seen in the above way by employees, how does it influence attitude, behavior and performance? Employees are concerned about the fairness of performance appraisals. Research has shown that employees feel that the appraisals are fairer when (1) the frequency of evaluation is higher, (2) goals are identified to eliminate weaknesses, (3) supervisors doing the evaluations have personal knowledge of the employee's performance and (4) the supervisor has personal knowledge of the subordinate's job duties. One approach that has been tried to enhance employee feelings of fairness is to have self-ratings. However, research indicates that this approach typically produces higher ratings than supervisor or peer ratings and provides less discrimination capability among employees. Research has also shown that employees overestimate their own accomplishments based on what they are told on their performance appraisal by their supervisor. Thus, it seems that employees often tend to think they have done a better job than their supervisors think they have.

Among the numerous performance evaluation methods, comparative judgement procedures, such as ranking or forced-distribution that make direct comparisons among employees are used by only 7% of U.S. firms and are usually less acceptable to employees than absolute judgement or behavioral description procedures (Zawacki & Taylor, 1976). Monitoring provides management with the opportunity to more easily compare employees' performance; printed out, quantitative data on performance are more readily comparable. But the nature of the information provided by monitoring may increase competition among employees and be an additional source of stress, especially for the "poor" performers who are directly identified as such by the monitoring. These individuals may be ostracized by their supervisor for not keeping up with the rest of the employees.

While employees feel evaluations are fairer when they contain specific goals to eliminate weakness, it has been shown that supervisor attempts to assist subordinates by pointing out improvements are seen as threatening to self esteem and can result in defensive behaviors. In fact, the greater the perceived threat the less favorable the employee's attitude toward the appraisal and the less improvement in job performance after the appraisal. Research indicates that the effects of job criticism are moderated by job tenure, with the newer employees being more dissatisfied with criticism and tending to downplay the significance and accuracy of the appraisal.

Literature on test anxiety (Wine, 1971; Liebling & Shaver, 1973) indicates that it is often debilitating and reduces performance under highly evaluative conditions, but may actually be facilitative under low evaluation conditions.

In summary, performance appraisal has characteristics that are similar to conditions that may occur with electronic monitoring of employee performance. As with incentive pay, performance appraisal requires the development of specific goals or standards that have to be met for rewards to be obtained. In addition, performance appraisal requires feedback on success and failure. It includes subjective elements that are open to biases and interpretation. Generally, employees do not like performance appraisal because it produces feelings of anxiety, due to its highly evaluative nature and potential impact on compensation, and also influences self-esteem and satisfaction. These effects are moderated by job tenure, with newer workers being most adversely affected. When dissatisfaction or anxiety occur, the hoped for improvements in employee performance are not obtained. This suggests that monitoring that is based on long times between feedback, is global and not specific, and is evaluative has the potential to produce stress particularly in workers with low job tenure.

MONITORING AND STRESS

"Big Brother" is watching you. You cannot escape his scrutiny. This message is one that resounds throughout the union halls of America. There is a general "paranoia" that electronic monitoring is the backbone of an impersonalized workplace in which every "sneeze" or every "breath" of a worker will be recorded and analyzed; and more importantly will be used in some way to punish workers, or to change their behavior. These fears have not been generated in a vacuum. Employer practices in using electronic monitoring have shown some of the fears to be well founded. Horror stories of monitoring misuse have been reported in the Washington Post (Perl, 1984), Dunn's Business Month (Hershman & Rozen, 1984), and ABC-TV Nightly News (Jennings, 1984).

Such stories include descriptions of the overwhelming effects of monitoring on worker psychological functioning, effects such as fear, anxiety, hatred and loss of self image. In addition, influences on health due to stress are reported. Westin (1984) indicates that management must realize that monitoring can cause increased production standards which employees feel are unfair. This can lead to morale and commitment problems, create physical and psychological stress and increases in undesired behavior such as absenteeism, turnover and lowered productivity.

While these effects all seem reasonable and have firm theoretical backing, currently there is insufficient research literature to support the contention that electronic monitoring leads to stress and diminished health. The results of our interviews with monitored workers provide preliminary evidence for such a linkage, but this will be discussed later. In addition, the excesses of some employers in applying monitoring which result in these horror stories most likely are not the norm for industry. While this cannot be established without more comprehensive surveys of employment practices regarding electronic monitoring, Westin (1984) provides the best available data on such practices from 110 companies. His data indicates more moderate application of electronic monitoring in personnel and administrative functions than are reported in the abuse stories. However, Westin's data base is too limited to be able to reflect general trends.

One approach to examining stress issues is to look at monitoring concerns from a "worst case" perspective. This allows for the establishment of the most damaging applications which then provides the basis for the limits of acceptable practice as well as direction for establishing policy considerations. Actually, employees are not informed as to the precise nature of the behavioral information which may be collected from a computer system and how this information may be used. For example, a telephone monitoring capability was included with a new telephone system for customer service operators. The monitoring system which distributed calls, timed the calls and allowed for unintrusive eavesdropping was instituted under the guise of workflow scheduling in order to determine the peak periods when extra operators are needed. But instead of using the monitoring system for that purpose only, management established standards (seconds per transaction) and used this information for discipline. Abusive use of dectronic monitoring systems by misinformed management can lead to workers' stress.

A major concern in electronic monitoring is the influences that it can have on worker self-image and on feelings of self-worth. In one sense, monitoring should enhance feelings of worth if the results of worker efforts are positive and the workers gets feedback to that effect. Likewise, management interest in the worker as a valuable resources can be demonstrated by the attention provided by monitoring. However, both effects may be seen differently by workers if poor performance can lead to some form of punishment or reprimand. This fear of evaluation can produce anxiety and heightened sensitivity to adverse feedback that may damage self-esteem and self-image. Both the type of technology and the context of the monitoring determine its influences on stress, not the monitoring process itself.

Tied to fear of reprimand is the pressure to perform above average that monitoring can induce. Some managers may feel that this is a desirable effect since it implies high production. But occupational stress research indicates that such work pressure is not conducive to good performance and brings about adverse health consequences (Cooper & Marshall, 1976; Smith, 1986).

In fact, there are a range of stressful working conditions that may be the outcome of electronic monitoring of employer performance. These include heightened work pressure, routinized work activities, paced work, potential for increased work standards and workload, variable work standards, lack of control over the tasks, lack of decision latitude, reduced peer social support, reduced supervisory support and fear of job loss.

The following is a summary of the implications of stress for workers and various job conditions that have been implicated as sources of worker stress all of which could be influenced by electronic monitoring of work performance. Before going into these job conditions it is important to understand how and why stress causes health problems and reduced performance.

Selye's (1956) viewpoint on stress, although controversial, appears to be the one most frequently cited in the literature. According to Selye, the presence of stress can be inferred in an individual from a very generalized physiological response pattern (e.g., increases in adrenaline secretion, the dumping of sugar into the bloodstream, and other related physiological processes) whose elicitation can be provoked by a wide variety of environmental agents and situations, such as drugs, fear, and job ambiguity. This conceptualization of stress provides a basis for the development of various illnesses, most notable psychosomatic diseases. Selye refers to these maladies as "diseases of adaptation," since they are not a direct function of the agent or situation that elicited the response pattern, but a consequence of the body's adaptive reaction to a wide range of environmental stimuli. While normally there is nothing wrong per se with escalations occurring in this response pattern, chronic elicitation has been shown to produce serious degenerative effects in specific bodily processes. Typically, these responses are essential to the organism's ability to control the internal and external environment. Often, elicitation of these responses occurs where the environmental stimuli should not cause such an intensive mobilization of the body's defensive apparatus and thus the reactions are inappropriate and maladaptive. In such instances, these responses will most likely increase the wear and tear on the body, especially if this elicitation process becomes chronic.

In Selye's conceptualization, the most essential feature concerns the intensity of the demand for readjustment or adaptation brought about by the stressor, regardless of whether it is pleasant or unpleasant. Selye's view deals primarily with the effects of the stressor on the physiological system, with the physiological response assumed to be independent of the individual's emotional state.

More recently, Levi (1972) has defined the relationship between workplace stimuli, emotional reactions and physiological responses. Levi has proposed a model by which job factors can create stress (distress) and lead to chronic disorders. In this model, environmental conditions impose demands on the individual who may perceive these demands as either stressful or not stressful. This perception is conditioned by many factors such as prior experience, knowledge, current emotional status, health status and genetically predisposing features. If the environmental condition is perceived to be stressful, then acute biologic and emotional responses occur. If these continue to occur with some consistency over a prolonged period of time they can lead to disease. Various intervening factors determine the potential for disease to develop. These include individual behavior patterns and coping style, genetic predisposition to disease, and emotional support from others, to name a few.

The theory of Selye can be linked with the job stress model of Levi, and based on this linkage it can be hypothesized that particular working conditions can influence emotional and biologic reactions, as well as the behavior of workers. If these conditions are perceived as unpleasant for a prolonged time, the resultant stress reactions can influence the development of disease. Thus, psychological factors, in terms of perceptions and emotions, influence the disease process. In addition, worker behavior plays a significant role in exacerbating or mitigating these emotional and biologic reactions, and adding to or reducing the potential for disease and/or accidents.

Generally, stress in the work environment stems from a mismatch in a combination of the following three sources: (1) the individual (e.g., personality attributes), (2) the environment (social and physical environments at work and at leisure), and (3) the task (e.g., mental load, pacing). This is an oversimplification of a complex process of interaction of these sources and for the sake of this document only task factors will be examined.

Two organizational factors have been shown to be of special significance for increased job stress and decreased worker health. These are: (1) job involvement or participation; and (2) organizational support, as reflected by supervisory style, support from managers and career development. Lack of participation in work activities has been demonstrated to result in an increase in negative psychological mood (Margolis et al, 1974; Caplan et al, 1975; Smith et al, 1981). In terms of organizational support, it has been shown that close supervision and a supervisory style characterized by constant negative performance feedback are related to high levels of stress and poorer worker health (Caplan et al, 1975; Smith et al, 1981). The implication of these findings is that excessive, impersonal electronic monitoring of employee performance that produces close supervision and constant negative performance feedback can promote worker stress.

It has also been demonstrated that workers' feelings of lack of involvement are related to stress and potentially to health complaints. (WHO, 1984; Rutenfranz et al, 1977; Karasek, 1981; Caplan et al, 1975; Gardell, 1976; Margolis et al, 1974; Haynes & Feinleib, 1980; Colligan et al, 1977). Electronic monitoring has the propensity to reduce worker feelings of job involvement and may in this way increase worker distress. The chances to participate and be involved in the job process may be diminished in work systems that are driven by employee performance monitoring.

Career development is another major organizational stressor that has been studied. Concern over chances for promotion has been shown to be a significant stressor for office workers while being passed over for promotion has been related to increases in both job stress and ill-health (Smith et al, 1981; Arthur & Gunderson, 1965). This paper has indicated that monitoring can have both beneficial and negative effects in this regard. If monitoring provides for more objective employee evaluations and employee promotions are tied into the evaluation process, then monitoring may have a positive impact on workers. However, if the monitoring is perceived as unfair and not representative of performance, then this could produce a stressful influence.

Security is the other side of career development. The threat of job loss is a very potent stressor. It has been tied to serious health disorders such as ulcers, colitis, severe emotional stress and patchy baldness as well as to increased muscular and emotional complaints. Monitoring has been used for employee dismissal due to unsatisfactory performance and such use can be very stressful.

Stress-related work-task factors that have been researched include task variety, task clarity (confusion), challenge, complexity, utilization of skills and abilities, and activity level. All of these factors have been related to increased stress and negative psychological states such as boredom, confusion and frustration and have also been related to increased risk of health disorders. In particular, monitoring may reduce task complexity, variety, challenge and skills use due to the need for management to simplify work tasks and break them down into measureable units that can be easily monitored. This increased the potential for job stress. Work role includes a number of job factors such as responsibility for others, job conflict, role ambiguity, accountability, authority, discretionary control, participation and job status. A number of studies have demonstrated that role ambiguity, job conflict and responsibility for persons are related to job stress and psychological problems (Caplan et al, 1975). The lack of discretionary control over work activities has also been shown to be related to increased risk of coronary heart disease. Lack of participation in work decisions is yet another source of increased worker stress. Monitoring can greatly reduce the amount of discretionary control and participation that work has unless specific actions are taken by management to include these elements in the use of the monitoring process.

Mental workload factors, such as quantitative underload/overload, and workpace, can cause stress. In this case, a balance is required to avoid negative health consequences. Underload is just as bad for your health as overload in that it can affect psychological well-being. Quantitative overload has been shown to be a significant stressor for various occupations including scientists, machine operators, and data-entry clerks. The impact of work overload varies from psychological disturbances to increased disease risk. Monitoring is often accompanied by the establishment of work standards to assess employee performance. These standards are often not based on scientific grounds, but on computer system capabilities (Smith et al, 1981).

If the standards are excessive they will produce stress. On the other hand, if a scientific basis is used to set the standards, this influence of monitoring could be stress reducing if prior workload requirements were excessive.

Workpace is a very important workload factor (Smith et al, 1981; Cakir et al, 1978). The speed or rate of work has been implicated as a significant issue in factory-worker ill-health. Recent technology, such as computers, that can operate at high speeds on a continuous basis has increased the pacing impact on office workers. Recent research suggests that pacing produced by computerization may have an even greater stress effect than factory pacing (Smith et al, 1981). Monitoring, and the establishment of excessive work standards has the potential to increase work pace and thus to produce stress.

Time pressure, such as having to meet deadlines, is a stressor that may interact with both work hours and workpace (Friedman et al, 1958). Studies have shown increases in stress level as difficult deadlines draw near. Monitoring may produce such deadline pressure on a constant basis that may be more damaging than simple deadline pressure.

Although there is insufficient research literature to support the contention that electronic monitoring increased stress and diminished health, the above review of literature shows that electronic monitoring has the potential to be stressful. Indeed electronic monitoring may create adverse working conditions such as paced work, lack of involvement, reduced task variety and task clarity, reduced peer social support, reduced supervisory support, fear of job loss, routinized work activities, and lack of control over tasks. The results of our interview with monitored workers provide preliminary evidence for such a linkage between stress and electronic monitoring.

SURVEY OF MONITORED WORKERS

To supplement the literature review, a survey was carried-out to assess employee perceptions of electronic monitoring and to establish potential behavioral, motivational and stress considerations. This survey cannot be considered as a representative evaluation of the workforce that is electronically monitored due to the nature of employees sampled and the small number of participants. There were 41 employees (40 females and 1 male), all members of unions (CWA, TNG, UFCW, AFSCME), from 5 employers (telephone company, hospital, insurance company, 2 newspapers) who participated (see Appendix 3 for the description of the workplaces). All were interviewed using a semi-structured interview format (see Appendix 1 for interview form). Fifteen of the interviews were conducted face-to-face and the remaining 26 were conducted via telephone. In addition to these interviews, supervisors, union stewards and national union representatives were interviewed concerning their impressions about electronic monitoring. Their responses will be used to illustrate important considerations but will not be in the analysis that follows.

The results of the survey can be broken into 6 major areas (see Appendix 2 and Tables 1 to 4 for interview results). These are satisfaction with work and technology, job demands, work content, work measurement and employee evaluation, performance monitoring and its influences and perceived stress.

This heterogeneous group of workers was quite happy with their jobs overall with 70 percent indicating they were satisfied with their job and 78 percent stating that their job was important to them. Over half said that their job made them feel good about themselves. Every employee felt that the technology they used was good and made their jobs easier, and helped them work faster and more efficiently. A classified advisor at a newspaper talks about computers as follows: "The computer is much more effective than typewriters: a larger volume of ads can be taken, retrieval of ads is easier, it is easier to correct things. It is much more sophisticated and makes the job easier." However, 78 percent reported that their equipment had broken down at some time. In fact, the number one reported problem with the technology was breakdowns or misfunctions. The breakdowns were most problematic for people who had to interact with customers. Misfunctions included transmission problems and losing input forcing the operator to redo the work. Overall, these workers were satisfied with their jobs and technology and would fight to keep the technology since they felt they can do their jobs better with it. Supervisors uniformly felt that the technology enhanced the work process and employee output. Union leaders were fearful that technology would replace workers without an equivalent increase in jobs of equal quality in the technology production industries. In addition, there was the fear of the loss of union membership that would not be recaptured in the new jobs.

In terms of job demands, these were jobs that all had fixed standards of production. Ninety percent of the workers indicated that they did not have any input into the determination of their own work rate. Over half of the workers indicated that they disliked their rate of work, but 47 percent indicated that they thought the rate was fair: "It is a fair rate of work but there is no allowance for variability of volume." Fifty-six percent would like to change their rate of work. Fifty nine percent of the workers felt constantly pressured to work hard, and only 31 percent said that they could get ahead in their work so that they could rest. Forty-one percent indicated that there was always a backlog of work to do. Interestingly, only 29 percent disliked their workload and 27 percent felt the workload was unfair. In summary, these jobs have a fast work pace and high perceived workload that employees would like to change, but which they feel are fair. A long-distance phone operator expresses her feelings about job demands: "I dislike this rate of work. It turned the job into factory work. It causes competition. Standards go up ..." Local union officials concurred that the work rates were fair. National union officials expressed concern that work standards are often set without regard to scientific principles of job analysis and design. They felt that monitoring of performance to enforce unfair work standards was a common practice and vowed to stop it.

The content of these jobs was not varied with only 5 percent indicating a lot of variety, 63 percent some variety, and 32 percent no variety or no response; but 68 percent liked their task variety. In terms of task clarity, 63 percent indicated that their work tasks were clearly defined. Thirty one percent indicated there were times when they did not know exactly what they had to do at work. When asked about their control over the decision making on their job about one third of those responding said they had some control, while fifty-nine percent of those responding said they had opportunities to participate in decisions on control. In summary, these workers felt that they had reasonable levels of task variety and clarity and some opportunity to participate in decision making, but they felt that management did not listen to their inputs, as a medical transcriptionist reports: "You can say your opinion, but often it doesn't matter. They know already what they want to do."

In the work evaluation and measurement area, seventy percent of the workers indicated that standard forms were used for annual performance evaluation. Eighty three percent were evaluated by their supervisors. When asked the purpose of these evaluations, the largest response was that they served no purpose (46%), followed by for promotion (29%), and for merit pay (10%). Forty nine percent of the workers felt that their performance evaluations were fair and 51 percent were satisfied with their evaluations. Seventy-one percent of the workers reported no opportunity for career development. In summary, this appears to be a typical group of workers in their perception of performance evaluation with a significant proportion feeling the evaluations were not useful or fair. Several reasons for performance evaluation unfairness have been given by workers: "It is not fair because emphasis is on speed.", "It is too subjective.", "The supervisor hardly knows the employees."

A series of questions were asked about how the workers felt about electronic monitoring of their work performance. The first set dealt with the mechanics of monitoring such as how it was done, when and what was monitored. The second set dealt with the type and influences of feedback received based on the monitoring process and the last set dealt with the effects of monitoring on the work process.

In all cases the employees were monitored by a computer system. For 37 percent of the workers there was also telephone eavesdropping to check on the quality of performance and 63 percent of the workers indicated that non-electronic monitoring of quality was performed by their supervisor. Ninety percent of the workers felt that their performance was monitored daily (actually 100 percent were continuously monitored). The electronic monitoring is basically for the quantity of output (94%). There are also some quality checks which are not done electronically but in most cases by the supervisor in an incidental, unplanned manner.

Workers indicated that they received feedback about the quantity of their work (94 percent) primarily with 56 percent indicating they also get supervisor feedback on quality sometimes. The feedback comes primarily from daily sheets on performance (41 percent) or from the supervisor (38 percent). Eighty four percent of the employees indicated that their supervisor make comments to them about their quantity and quality of production. Sixty nine percent have their performance compared to that of other employees.

When asked about the accuracy of the monitoring system, 82 percent felt the information was accurate, but 60 percent felt that the monitoring information did not give management a good picture of their performance. Some employees' comments were that the system only provided numbers, that it did not take into account personal knowledge, skills or the quality of customer interaction: "Monitoring doesn't take into account the demands of the whole job.", "Only quantity is measured. The effort and time for a task are not seen. The knowledge of the job is not measured." Finally, they felt it was not very substantial as a base to evaluate people. Union officials at both the local and national levels were highly critical of monitoring systems that dealt solely with the quantity produced. They stressed the absence of good measures of worker effort, quality or motivation in current monitoring systems and generally felt that this absence made such systems ineffective and poor representations of worker performance. Supervisors felt that the monitoring of individual worker quantity of output individual worker quantity of output gave them important information that could be used to motivate individual workers to increase their level of performance. They thought that it provided insight into who the best workers were. They also found the information on the productivity of the office as a whole very useful to deal with top management when more work has to be done and when more people are needed to keep up with the workload.

Fifty five percent of the monitored workers felt the feedback they received was helpful, mainly because feedback gives them milestones in reaching the standard: "I can see whether I need to work more." Sixty four percent felt the monitoring system and feedback did not help them correct their performance or errors. Only 21 percent could determine when they could receive feedback. When asked where they would like to get their feedback from 45 percent from their supervisor, 34 percent from the machine and 17 percent from both.

The influence of the monitoring system on the job design, worker behavior and worker motivation were examined. All respondents indicated that they had no control over the monitoring system in any way. Eighty-eight percent said that the monitoring system did not help them gain control over their work, while 68 percent indicated that they did not have any control over their work decisions. Fifty-nine percent reported some participation in job decision making. A major influence of monitoring was on supervision with 84 percent reporting that monitoring changed the style of supervision. In most cases the impact on supervision style was negative: "Not only the supervisors can listen to you, but also they know exactly what you are doing without having to see you." Seventy-two percent indicated that they liked their supervisor. Among those who reported a change in supervisor style, 60% indicated that supervisors relied more on numbers, on the information given by the monitoring system; 34% found the relationship between employees and supervisor more strained; 28% thought that supervision was closer, while 22% thought that supervision was remote and/or distant; finally 19% indicated that the monitoring system put pressure on supervisors. Seventy-two percent indicated their supervisors had praised their performance, while 40 percent received supervisor complaints at sometime. Ninety percent felt good from the supervisory praise and 82 percent felt bad by the criticism. Monitoring had only limited influence on worker's skipping breaks (33 percent) or working late (13 percent). However, monitoring did influence taking to fellow workers (80 percent) and socializing at work (75 percent). Thus some workers may lack social support, as a medical transcriptionist says: "On a bad day I can't talk to anyone about it or I won't make the standard."

The monitoring system does not motivate the majority of workers to work harder (57 percent) or better (72 percent). When asked if the monitoring system made them feel good about performing well, 64 percent said no.

The final area of examination dealt with the stress reported by the workers. Eignty-nine percent of the workers reported feeling stressed by the monitoring system. In this regard, 88 percent felt anxious, 88 percent felt tense, and 89 percent felt angry. In terms of work pressure 59 percent reported such pressure as a problem, while 83 percent felt "watched" by the monitoring system. Telephone operators ("When they are listening to me, I'm very upset because you can't stop it.") and word processors ("I feel watched all the time. It's like a classroom, a child.") were among the respondents that resented being watched.

Overall, the electronic monitoring of workers was perceived as a source of stress even though the worker understood the need for monitoring and the vast majority felt that the feedback received was accurate. The workers in this survey were generally satisfied with their jobs in terms of workload, work standards and job content. They liked their supervisors. They felt that their jobs were an important aspect of their life. They liked the technology that they worked with and would not give it up without a fight. However, most felt that the monitoring systems as presently established did not motivate them nor help them to improve their performance. Many indicated that they would prefer more feedback and more frequent feedback. They felt that improved feedback would help them perform better. A major impact of monitoring was on the style of supervision which changed with the introduction of monitoring. Finally the workers felt that monitoring cannot be helpful unless it includes more than quantity of output information.

SUMMARY OF FINDINGS

The literature evaluation and the survey study taken together provide some general conclusions about the potential influences of electronic monitoring and how monitoring can be best designed to provide the most beneficial effects.

Monitoring has the capability to change job design substantially. All theories of human performance at work stress the significance of having up-to-date, accurate information about individual performance so that aspects of workplace redesign or personal motivation can be applied to increase productivity. While the theories may differ on the use of the information, they agree on the need for such information. Thus it is apparent that electronic monitoring can play a significant role in providing this information which can be applied in accordance with whichever theory has been selected. However, it is also clear that monitoring must provide more significant information than just the quantity of individual output, it must also provide insight into the quality of output and the individual contributions of workers not adequately reflected in sample measures of quantity and quality.

Monitoring has direct effects on employee perceptions of stress and has the potential to influence worker motivation and behavior. If monitoring is used in an evaluative way by management then it can create distress, influence individual motives and goals adversely and could have both positive and negative effects on performance. If monitoring is used to provide accurate, meaningful feedback in a timely way and is non-evaluative, it provides the basis for enhanced goal setting and motivation and provides the cues necessary to improve performance. Such monitoring also can provide the basis for establishing equitable and reasonable work standards that influence performance motivation under incentive conditions, as well as worker perceptions of fairness and job satisfaction under non-incentive conditions. A major fear of organized labor is that continuous monitoring systems will be used to establish unfair production standards which will overtax worker capabilities. To counteract such outcomes it is likely that employees will limit their performance as they have under incentive systems so that work standards will not increase. This will defeat the positive benefits of monitoring for performance motivation and enhancement, and therefore the most effective uses of monitoring will be for non-evaluative purposes.

Monitoring can provide the necessary feedback climate that the research literature extols as necessary for the best possible employee performance. But monitoring also changes the nature of jobs and most importantly the way workers interact on the job. Socialization and talking are reduced in most automated worksettings; and monitoring adds the concern about being watched on a frequent basis. Thus, the workers are afraid to socialize. In our survey, all of the workers expressed the desire to work hard and to produce quality products. This is reflected by the fact that the vast majority indicated that they produced more than the established work standard at their worksites even though they did not receive extra payment for this. They all also commented on the importance of work as a place to socialize and to interact with others. It seems reasonable that such socialization can be accommodated in automated work systems and that monitoring can be established in such a way as to not diminish social interaction.

Monitoring also influences the way in which workers are supervised. Smith et al (1981) indicated that computer automation with monitoring produced more coercive, stricter number-counting supervisory style which replaced a more helpful, less performance oriented supervisory approach. Our survey supports the belief that most employees feel that supervision changes with monitoring and that the changes are for the worse. Again, this suggests that monitoring should not be used as part of an individual evaluation approach but should be used to feed back information to individuals about their performance in a non-evaluative way so that they can make necessary corrections in their behavior.

Monitoring can influence motivation by the type of information feedback to individuals. Value judgement information such as that in annual performance evaluations generally is not perceived as important, accurate or worthwhile by workers. In fact workers misjudge what they are told about their performance. Performance feedback on a continuous basis can help in setting individual performance goals, can act as a direct performance motivator and can help direct behavior that is tied to financial incentives.

Thus, the information and cues presented act as primary sources for motivating worker behavior.

Whether monitoring can influence the health of workers is not clear. There is no research about health effects and only a limited amount of research on the stress effects of monitoring. Thus, there is no basis on which to demonstrate direct health effects due to monitoring. However, monitoring has been shown to be associated with worker stress (Smith et al, 1981) and to have the necessary influences on job design to be a potent stressor (Cooper and Marshall, 1976; Smith, 1986). Thus, if not used properly electronic monitoring has the potential to be a serious threat to worker health as mediated through increased job stress and reduced job satisfaction.

CONCLUSIONS

It is clear that electronic monitoring of employee performance is a necessary element in a competitive, productive work system. If the United States is to keep the international competition at bay, then effective utilization of employee resources is vital. In this light, employee resources must be recognized as a vital component of workplace modernization; and that without a highly motivated workforce, the modernization will not be as successful. Monitoring, and its related motivational processes such as feedback, goal setting and performance evaluation are keys to the success of electronic workplace enhancements. Monitoring can be an anchor in these efforts. In fact, most employees want to have feedback about their performance so that they can gauge their behavior, evaluate their goals, and as a source of internal and external motivation. Such feedback would be absent without effective monitoring.

On-the-other-hand, monitoring can establish the framework for a work environment that is coercive, threatening and frightening to employees. When monitoring is used to invest greater and greater control in management and provides the basis for higher and higher work standards that employees feel are unfair, then it has the potential to be very stressful, and to degrade worker motivation and performance.

Thus, while monitoring is at the heart of successful job design because of its uses in providing feedback, goal setting, performance evaluation, and employee rewarding/compensating, it also is at the heart of stressful working conditions. The problem lies not in the actual monitoring of performance, but in the system by which performance is monitored and the way in which the monitoring is applied to control and motivate worker behavior. Successful monitoring implies that worker performance can be quantified in a meaningful way. It is clear that simply reporting on the quantity of work output will not provide adequate performance feedback to workers for productivity gains, quality improvement or for motivating worker performance (including quality and individual contributions are needed to enhance the use of electronic monitoring). If performance cannot be adequately measured, it cannot be adequately monitored and proper feedback cannot be given to the worker. Such feedback is the base upon which successful monitoring programs for enhancing worker performance are built.

To be successful performance monitoring must be perceived as fair by the employees being monitored. Some necessary conditions for this would be that the measurements of performance being monitored: (1) have value to the worker and the activities being undertaken, (2) be from a good source, accurate and verifiable, (3) provide positive feedback, (4) provide necessary information in a timely way in light of uncertainty or ambiguity, (5) provide cues to proper behavior, and (6) have reasonable standards preferably based on employee input. Such a monitoring system requires planning and a great deal of work in making it operational. Standard software packages provided by manufacturers of monitoring equipment do not have many of these elements and thus may contribute to stress. In fact, Westin (1984) indicates that many employers do not use the approaches inherent in the standard software as they perceive that it fails to meet many of the basic requirements for effective employee motivation.

Proper application of electronic monitoring enhances job design by building intrinsic motivation into work activities. This is typically accomplished by increasing worker control over the task through participation in goal setting and work standards establishment, and through feedback that assists the worker in gaining control over task activities and by obtaining satisfaction from successful performance. Such processes imply that task content will not be degraded by the monitoring. Sometimes, in attempting to provide meaningful, verifiable, accurate feedback, organizations take the easy way out by simplifying job tasks to make them more amenable to measurement and the establishment of work standards. This is a natural tendency that must be controlled since the reduction in job content will negate gains from enhanced feedback and participative goal setting. To enhance motivation and its influences on performance, as well as the positive benefits of feedback and goal setting, it is necessary to keep jobs complex and to develop more sophisticated hardware, software and work evaluation methods to provide the needed monitoring parameters. If jobs are simplified, the production gains are reduced, and in addition job characteristics become similar to those that have been shown to be very stressful with adverse health consequences (Smith, 1986).

A final comment regarding motivation concerns the use of incentives in the technology driven jobs of the future. It is to be expected that behavioral scientists and industrial engineers will want to use improved methods of work evaluation and monitoring to establish more effective incentive systems for influencing worker production. While these systems can provide a base level of output, as Rothe (1978) has demonstrated there is a great variability in performance over time under incentive pay schemes and this reflects social as well as individual motivational factors. More effective monitoring systems will enable managers to achieve more precise control over the standards of performance and over the variability in individual worker performance. Whether this will be good or bad for workers remains to be seen. However, this approach has some weaknesses from a stress perspective. Changing standards of performance through technology rather than through worker participation invests negative qualities in the technology from the worker's perspective and tends to promote fear, anxiety, anger and adverse behavioral responses. It invests control over the job in the technology, rather than in the workers and could cause increased stress. Those employers using incentive based performance approaches will need to look carefully at the issues of worker participation in work standards evaluation and in designing greater worker control over job tasks through enhanced feedback based on performance monitoring. Without such considerations, productivity may suffer and stress could become a more serious problem in the future.

Monitoring has a very positive role to play in worker performance appraisal. Serious deficiences in current appraisal approaches because of the subjective nature of some of the factors being evaluated, the lack of specific information about performance on a well defined time line and the use of global goals that may not relate to daily performance or motivation may be overcome via monitoring. Proper use of electronic monitoring can provide a data base for more objective performance appraisal over a well defined time line. It has discriminate validity, if properly designed can be fair, is unambiguous and can be compared to objective standards rather than global goals. Thus, monitoring may be the key to improving the performance appraisal process which currently has little support from supervisors or employees.

POLICY CONSIDERATIONS

1. Electronic performance monitoring is an outgrowth of advances in the use of computer technology in the workplace. The continued application of computer technology is a vital element in the United States' efforts to reestablish America as a competitive producer on world markets. While electronic monitoring is a small part of this new automation effort, it is a central element in the effective use of the technology and in maintaining a highly motivated and productive workforce. As such, the Congress should support the proper use of electronic performance monitoring as a part of any comprehensive economic policy dealing with the use of new technology in the workplace. The key to electronic monitoring and improvements in worker production are the applications of current knowledge about the best types of feedback to provide employees, the rise of monitoring to help establish appropriate work standards and employee goals, and the most beneficial uses of monitoring in evaluating worker performance and rewarding/punishing workers.

2. Electronic monitoring of worker performance is an accepted management practice and a "right" that management exercises in conducting business in an efficient manner. While recognizing the facts that electronic monitoring is a

management prerogative, it should also be recognized that management practices should and must conform to basic principles of ethics and moral considerations for individual dignity and rights to meaningful, enjoyable, satisfying and healthful work. In a May 14, 1986 discussion with Professor Bertil Gardell in Stockholm, Sweden about these concerns, he impressed on me the vital nature of the ethical and moral considerations of monitoring which he felt must take precedence over production considerations. This philosophy is typical of Swedish thinking about the important nature of work in our lives. For them work that is meaningful and satisfying is a right rather than a privilege and in their system it is management's legal as well as ethical and moral responsibility to ensure this right. Since electronic monitoring that is not properly designed has a high potential to produce worker stress, reduce the meaningfulness of work and create job dissatisfaction, Sweden will most likely place legal limits on how monitoring can be conducted and what can be monitored. The Congress of the United States may also want to set limits on electronic monitoring based on the ethical and moral considerations as it influences job design and worker dignity and health. Congress might consider limits in areas like organizational policies, personnel practices, disciplinary procedures, payment systems, access to information on performance, etc.. Given our current knowledge, these issues should be examined more in-depth so that specific limits be set. These limits should be independent of productivity considerations.

3. Electronic performance monitoring represents an increasing trend reflective of increased computerization of work process. Like all new advances, it is still too early to know the exact direction(s) that it will take. Research on electronic monitoring is very sparse, and it would be premature to try to establish that one direction is more legitimate than

another. However, it is reasonable to assume, based on various theories of worker motivation and performance, that electronic monitoring is an important element in successful international competition through a more productive workforce. Because of the lack of research and due to the significant nature of electronic monitoring, it is suggested that Congress encourage research in industry and fund scholarly research in the following areas:

a. The development of work evaluation tools and methods that will increase the ability to electronically monitor complex work. This would include hardware for sensing worker activities, software for evaluating complex input and providing worker feedback and improved methods and procedures for evaluating complex jobs.

b. Demonstration projects that evaluate the effectiveness of various approaches in motivating worker productivity in electronic monitoring environments. The use of large federal agencies such as the Social Security Administration and the Internal Revenue Service as model project sites should be encouraged. Funding to these agencies for such projects would increase their likelihood.

c. Development of work analysis and measurement methods that consider both quality and quantity of work. Currently, a major weakness of electronic monitoring systems is that they emphasize quantity measures over qualitative indicators of performance. This occurs primarily because the technology for electronic monitoring is not advanced sufficiently to examine quality issues in accurate and cost effective ways. A critical research need is to examine the relative merits of quantitative versus qualitative feedback to workers in terms of output effectiveness and job design considerations. It is quite apparent that good job design that enhances work esteem, dignity and motivation requires measures of both quantity and quality. The quality considerations imply that good methods of electronically evaluating worker production quality also have to be developed, which is also a critical research need.

d. Examination of the stress and health consequences of electronic monitoring, and determination of the most beneficial monitoring approaches.

4. Congress should look into the important concern of the use of monitoring for punitive measures. Research should be undertaken to determine the feasibility of developing legislation that would prohibit the use of electronic monitoring for employee discharge. The primary negative influence of continuous electronic monitoring is the work pressure and fear generated by concerns with failure to perform adequately and resultant punishment, the ultimate being dismissal. That is not to say that failure to perform adequately could not be used as grounds for dismissal; only that the continuous electronic performance monitoring should not be used as the basis for such dismissal. This would serve to remove a major fear and stress factor from electronic monitoring and increase its potential benefits as a positive motivational resource to enhance productivity. Before legislation is considered, a pilot examination of this concept could be undertaken in volunteer industries supported by research funds allocated by Congress. If this concept proves workable, it would provide a major impetus to union and worker acceptance of electronic monitoring.

5. An important roadblock in using electronic monitoring to develop new ways of designing better jobs for workers and improving the management of the work process is current federal labor legislation that limits the roles of managers and workers in interactivity with each other and in decision making. The most effective use of electronic monitoring for enhancing productivity and improving job design will be likely to occur as feedback

about individual performance is given to the individual who will be empowered to make decisions about how the work is conducted, as well as what is to be done, when and where it is done. Such a shifting of "power" from management directly to the worker can be problematic under current federal legislation. Congress needs to study how current federal legislation will limit the capabilities of electronic monitoring to improve job design, and whether these laws need to be modified in light of technological innovation and its influence on the workplace.

6. Congress should encourage employer associations to develop educational materials for their members on the positive and negative aspects of electronic monitoring of employees.

7. With the ever increasing application of technology in the workplace and the increased use of electronic monitoring, Congress should establish a resource within the federal government that could provide employers (with special emphasis on small employers), unions and employees with educational materials and consultative services in dealing with technology and monitoring considerations. For the United States to achieve the most favorable international competitive position, it is necessary for the federal government to play an active role in setting a national policy and in providing scientific and research direction to industry. Such a centralized approach is required because of the rate at which technology is being implemented at all levels (large and small) of the economy and because of the rate at which newer and newer technology is being developed and to provide the necessary focus in direction that can produce answers in a timely fashion. Such efforts cannot be left to the academics since they are mainly interested in theory and not practice. They cannot be left to industry because of vested interests. They logically fall on the federal government and are legitimate, even in these

times of fiscal constraint, because these are the types of efforts that will propel the economy to the necessary heights to resolve the current budgetary and fiscal problems. Federal agencies can be both scholar and applied practitioner and are thus best equipped to tackle the non-research issues.

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TABLES
RESULTS OF INTERVIEWS

Table 1. Employee Satisfaction and Stress

	Percent Respondents		
	Yes	No	NR*
Satisfaction with work			
.Satisfied with job	71%	22%	7%
.Job important	78%	7%	15%
.Job makes feel good	54%	17%	29%
Stress	Yes	No	
.Feel stressed because of the monitoring system	89%	11%	
.Feel anxious because of the monitoring system	88%	12%	
.Feel tense because of the monitoring system	88%	12%	
.Feel angry because of the monitoring system	89%	11%	
.Feel watched by the monitoring system	83%	17%	

*NR = No Response

Table 2. Employee Perceptions of Job Demands

Demand	Percent Respondents		
	Yes	No	NR*
Rate of Work			
.Like rate	29%	51%	20%
.Rate fair	47%	41%	12%
.Like to change rate	56%	20%	24%
.Have input to work rate	7%	90%	3%
Workload			
.Feel pressure to work hard	59%	10%	31%
.Can get ahead to rest	31%	39%	30%
.Always a backlog of work	41%	25%	34%
.Like workload	27%	29%	44%
.Workload fair	34%	27%	39%

*NR = No Response

Table 3. Employee Perceptions of Job Content

	Percent Respondents		
	Yes	No	NR*
Task Variety			
.Like task variety	68%	17%	15%
Task Clarity			
.Tasks clearly defined	63%	20%	17%
.Times when don't know what to do	31%	52%	17%
	Yes	No	
Control			
.Have some control over the decisions on job	32%	68%	
.Have some opportunities to participate in decisions on job	59%	41%	

*NR = No Response

Table 4. Employee Perceptions of Monitoring Features

	Percent Respondents Yes	Percent Respondents No
Feedback		
.Get feedback about the quantity of work	94%	6%
.Get feedback about the quality of work	56%	44%
.Feedback helpful	55%	45%
.Determine when receive feedback	21%	79%
.Supervisor makes comments about quantity or quality of work	84%	16%
.Performance rating compared to others'	69%	31%
Monitoring Characteristics		
.Information given by monitoring system accurate	82%	18%
.Monitoring system gives management a good picture of performance	40%	60%
.Monitoring system helps to correct performance or errors	36%	64%
Influence of Monitoring		
.Monitoring system helps to gain control over work	12%	88%
.Monitoring system influences supervision	84%	16%
.Monitoring system makes skip breaks	33%	67%
.Monitoring system makes work late	13%	87%
.Monitoring system impacts talking to fellow workers	80%	20%
.Monitoring system influences socializing at work	75%	25%

APPENDIX 1: INTERVIEW FORM

Hello

Is this _______________________?

I'm _______________________ from the University of Wisconsin working with Professor Michael Smith on a study on workplace monitoring.

We want to thank you for volunteering to participate in this study The study is commissioned by the U.S. Congress because of their interest in how the workplace can influence the quality of workers lives.

I have a series of questions that I am going to ask you. If any are unclear please ask me to repeat the question or to clarify it.

Your answers will remain anonymous. We will not put your name on the answers so that no one will know how you answered.

Do you have any questions?

1-Sex: Age:

2-How long have you been working for your current employer?

3-What is your job title?

4-What do you like most about your job?

5-What do you least like about your job?

6-What do you like most about your employer?

7-What do you least like about your employer?

There are many conditions of work that are of interest to us. I would like you to tell me how you feel about the following work conditions.

WORK HOURS

8-When do you start to work?

9-When do you finish to work?

10-Do your starting and ending times change from day to day or week to week?
If yes how?

11-How many hours per day do you work?

12-How many hours per week do you work?

13-Is your work schedule flexible?

14-Do you work overtime?

15-On the average how much overtime do you work per day?
per week?
per month?

16-Are there any times during the year when your overtime increases significantly?

17-Do you feel any pressure to be at work at specific times or can you be there when you want?

If yes why?

TECHNOLOGY

*18-What technology do you use? (by technology we mean the kind of machinery, computer or electronic devices you use)

*19-How effective is the technology in accomplishing your work?

a-Does it provide aids for accomplishing work tasks?

b-Does it break down?

If yes how often?

c-Are you aware of other technology that you feel can do the tasks better?
If yes what technology?

*20-Do you have any problem with the technology you use?
If yes what is the problem?

(after respondent has given the problems or answered no, then ask about the following problems)

a-Do you encounter problems with the responsiveness of the technology?

Does it lag behind your rate of work?

What type of lag problems do you encounter?

b-Does the technology ever misfunction? That is, does it make mistakes?
What are these mistakes?

RATE/SPEED OF WORK

*21-How many units per hour do you have to do? (units are basic outputs or products, e.g. letters, forms, keystrokes, characters, telephone calls)

22-Are you free to decide how many units per hour you have to do? (who sets the workload)

23-Do you like or dislike the rate of work?
Why?

24-Is it a fair rate?

25-Who determines your rate?

26-Do you have any input in the determination of the rate?
If yes what is this input?

27-Would you like to change your rate of work?
How?

WORKLOAD

28-Do you constantly feel pressure to work hard?

29-Can you ever get ahead so that you can rest?

30-Is there always a backlog of work to do?

31-Do you like or dislike your workload?
Why?

32-Is your workload fair?

33-Does your workload vary?
If yes how does it vary?

TASK VARIETY

34-What are the different types of work (tasks) you have to do?
Listing

35-Do you like or dislike your task variety?
Why?

TASK CLARITY

36-Who defines your task?

37-Are your work tasks clearly defined?

38-Are there times when you don't know exactly what you have to do?
When?

QUALITY OF WORK

39-How is your quality of work measured?

40-Are there specific standards of quality?

TASK REQUIREMENTS

41-How many times do you have to redo a unit of work?

*42-How much does your unit of work contribute to a final product?

Now we want to ask you some questions on how you are evaluated at work. We are going to start with daily work evaluation and monitoring. We are not interested in your specific performance level but how you feel about how you are evaluated.

PERFORMANCE MONITORING

43-How is your work monitored?

44-How often is your performance measured?

44-Do you get feedback on your performance?
How?
When?

45-Does the feedback you receive address the quantity of your work?
The quality?

46-Does your supervisor make any comment on the quantity or quality?

47-Is your performance rating compared with other workers?

48-Can you control the monitoring system in any way?
How?
If not why not?

49-Can you log on or log off whenever you want?

50-Is the information given by the monitoring system accurate?

51-Does the monitoring give management a good picture of your performance?
If no why not?

52-Do you think the feedback you receive is helpful?

53-Is the timing of the feedback helpful?

54-Who determines when you get feedback?

55-Is this feedback useful for you to improve your performance?

56-Would you rather receive feedback from the machine or your supervisor?

57-Does the monitoring system help you to correct your performance? to correct your errors?

58-Does the monitoring system motivate you to work harder?

59-Does the monitoring system motivate you to work better?

60-Does the monitoring system act as a whip to make you work harder?

61-Do you feel watched by the monitoring system or do you feel it is neutral?
Please explain.

62-Does the monitoring system make you feel good about performing well?

63-Do you feel stressed because of the monitoring system?

anxious

tensed

angry

64-Would you like to change anything in the monitoring system?
If yes what?
How can this change be done?

65-Does the monitoring system make you behave differently than you normally would at work?
How?

a-Does the monitoring system make you skip breaks?

b-Does it make you work late?

c-Does it impact your talking to fellow workers?

d-Does it influence socializing at work?

Now we are going to talk about your annual performance evaluation.

PERFORMANCE EVALUATION

66-How is your performance evaluation accomplished?
Is a standard form used?

67-Who evaluates you?

68-How do you feel about your performance evaluation?

69-Is it fair?

70-Are you satisfied with your performance evaluation?
If not why not?

71-For what purpose is your performance evaluation used?

For merit?

For pay increases?

For promotion?

72-How many opportunities for career development do you have?

SUPERVISION

73-Do you like your supervisor?
Why?

74-Does your supervisor ever give praise on your performance?

75-Do you feel good when you get praised?

76-Does your supervisor ever complain about your performance?

77-Do you feel bad when you are criticized?

78-Does the monitoring system have an influence on how you are supervised?
If yes how?

79-Has the style of supervision changed due to monitoring?
If yes how?

CONTENT

80-Are you satisfied with your job?

81-Is your job important to you?
Why?

82-Is your job more or less important than other parts of your life?

83-Does your job make you feel good about yourself?

84-Do you have any control over the decisions that affect your work?

85-How many opportunities to participate in these decisions do you have?

86-Does the monitoring system help you to gain control over your work?
If yes how?

87-If you could change anything in your job what would you change?

88-What do you most like about the monitoring system?

89-What do you least like about the monitoring system?

APPENDIX 2: INTERVIEW RESULTS

Hello

Is this ________________________?

I'm ___________________________ from the University of Wisconsin working with Professor Michael Smith on a study on workplace monitoring.

We want to thank you for volunteering to participate in this study The study is commissioned by the U.S. Congress because of their interest in how the workplace can influence the quality of workers lives.

I have a series of questions that I am going to ask you. If any are unclear please ask me to repeat the question or to clarify it.

Your answers will remain anonymous. We will not put your name on the answers so that no one will know how you answered.

Do you have any questions?

Legend:
Y = yes
N = no
NR = no response

1-Sex: F=40 Age: mean= 34.5 years , SD=10.4
M=1

2-How long have you been working for your current employer?
5.9 +/- 4.3 years

3-What is your job title?

4-What do you like most about your job?

5-What do you least like about your job?

6-What do you like most about your employer?

7-What do you least like about your employer?

There are many conditions of work that are of interest to us. I would like you to tell me how you feel about the following work conditions.

WORK HOURS

8-When do you start to work?

9-When do you finish to work?

10-Do your starting and ending times change from day to day or week to week?
If yes how?

11-How many hours per day do you work?

12-How many hours per week do you work?

13-Is your work schedule flexible? Y=21 N=15 NR=5

14-Do you work overtime? Y=21 N=20

15-On the average how much overtime do you work per day?

per week?

per month?

16-Are there any times during the year when your overtime increases significantly?

17-Do you feel any pressure to be at work at specific times or can you be there when you want?

Y=16 N=12 NR=13

If yes why?

TECHNOLOGY

*18-What technology do you use? (by technology we mean the kind of machinery, computer or electronic devices you use)

*19-How effective is the technology in accomplishing your work?

a-Does it provide aids for accomplishing work tasks?

b-Does it break down? Y=32 N=2 NR=7

If yes how often?

c-Are you aware of other technology that you feel can do the tasks better?
If yes what technology?

*20-Do you have any problem with the technology you use?
If yes what is the problem?

(after respondent has given the problems or answered no, then ask about the following problems)

a-Do you encounter problems with the responsiveness of the technology?

Does it lag behind your rate of work?

What type of lag problems do you encounter?

b-Does the technology ever misfunction? That is, does it make mistakes?
What are these mistakes?

RATE/SPEED OF WORK

*21-How many units per hour do you have to do? (units are basic outputs or products, e.g. letters, forms, keystrokes, characters, telephone calls)

22-Are you free to decide how many units per hour you have to do? (who sets the workload)
Y=6 N=33 NR=8

23-Do you like or dislike the rate of work?
Why?
LIKE=12 DISLIKE=21 NR=8

24-Is it a fair rate? Y=19 N=17 NR=5

25-Who determines your rate? superior=5 engineering=7
management=22 computer=1 don't know=2 NR=4

26-Do you have any input in the determination of the rate?
If yes what is this input?
Y=3 N=37 NR=1

27-Would you like to change your rate of work?
How? Y=23 N=8 NR=10

WORKLOAD

28-Do you constantly feel pressure to work hard?
Y=24 N=4 NR=13

29-Can you ever get ahead so that you can rest?
Y=13 N=16 NR=12

30-Is there always a backlog of work to do?
Y=17 N=10 NR=14

31-Do you like or dislike your workload?
Why?
LIKE=11 DISLIKE=12 NR=18

32-Is your workload fair?
Y=14 N=11 NR=16

33-Does your workload vary?
If yes how does it vary?
Y=19 N=11 NR=11

TASK VARIETY

34-What are the different types of work (tasks) you have to do?
Listing A Lot=2
Some=26
None=10
NR=3

35-Do you like or dislike your task variety?
Why?
LIKE=28 DISLIKE=7 NR=6

TASK CLARITY

36-Who defines your task?

37-Are your work tasks clearly defined?
Y=26 N=8 NR=7

38-Are there times when you don't know exactly what you have to do?
When?
Y=13 N=21 NR=7

QUALITY OF WORK

39-How is your quality of work measured?
Y=39 N=1 NR=1

40-Are there specific standards of quality?
Y=36 N=4 NR=1

TASK REQUIREMENTS

41-How many times do you have to redo a unit of work?
Y=15 N=15 NR=11

*42-How much does your unit of work contribute to a final product?

Now we want to ask you some questions on how you are evaluated at work. We are going to start with daily work evaluation and monitoring. We are not interested in your specific performance level but how you feel about how you are evaluated.

PERFORMANCE MONITORING

43-How is your work monitored? Computer=41
Telephone=15
Supervisor=26

44-How often is your performance measured? Daily=22 Weekly=3
Monthly=1 Daily + Weekly=4 Daily + Monthly=7 Continuously=3 NR=1

44-Do you get feedback on your performance? Y=35 N=1 NR=5

How? Monthly report=5 Daily sheet=13 Supervisor=12
Myself=2 NR=9

When? Daily=7 Weekly=9 Monthly=7 Several times per day=3
Varies=4 Daily + Monthly=1 Yearly=1 NR=9

45-Does the feedback you receive address the quantity of your work? Y=31 N=2 NR=8
The quality?
Y=19 N=14 NR=8

46-Does your supervisor make any comment on the quantity or quality?
Y=31 N=6 NR=4

47-Is your performance rating compared with other workers?
Y=24 N=11 NR=7

48-Can you control the monitoring system in any way? Y=0 N=36 NR=5
How?
If not why not?

49-Can you log on or log off whenever you want?
Y=27 N=5 NR=9

50-Is the information given by the monitoring system accurate?
Y=28 N=6 NR=7

51-Does the monitoring give management a good picture of your performance? Y=14 N=21 NR=6
If no why not?

52-Do you think the feedback you receive is helpful?
Y=16 N=13 NR=12

53-Is the timing of the feedback helpful?
Y=16 N=13 NR=12

54-Who determines when you get feedback?
Supervisor=18 Management=8 Myself=7 NR=8

55-Is this feedback useful for you to improve your performance?
Y=28 N=6 NR=7

56-Would you rather receive feedback from the machine or your supervisor?
Machine=11 Supervisor=13 Both=5 NR=12

57-Does the monitoring system help you to correct your performance? to correct your errors?
Y=13 N=23 NR=5

58-Does the monitoring system motivate you to work harder?
Y=16 N=21 NR=4

59-Does the monitoring system motivate you to work better?
Y=10 N=26 NR=5

60-Does the monitoring system act as a whip to make you work harder?
Y=29 N=5 NR=7

61-Do you feel watched by the monitoring system or do you feel it is neutral? Watched=34 Neutral=4 NR=3

Please explain.

62-Does the monitoring system make you feel good about performing well?
Y=12 N=18 NR=11

63-Do you feel stressed because of the monitoring system?
Y=34 N=4 NR=3

anxious Y=29 N=4 NR=8

tensed Y=29 N=4 NR=8

angry Y=31 N=4 NR=6

64-Would you like to change anything in the monitoring system?
If yes what? Y=29 N=8 NR=4

How can this change be done?
Incentives=1
Get rid of it=11
Input of employees=4
Technology=1
Flexibility=5
Lower standards=4

65-Does the monitoring system make you behave differently than you normally would at work? Y=11 N=11 NR=19

How?

a-Does the monitoring system make you skip breaks?
Y=11 N=21 NR=9

b-Does it make you work late?
Y=4 N=27 NR=10

c-Does it impact your talking to fellow workers?
Y=28 N=27 NR=10

d-Does it influence socializing at work?
Y=24 N=8 NR=9

Now we are going to talk about your annual performance evaluation.

PERFORMANCE EVALUATION

66-How is your performance evaluation accomplished?
Is a standard form used?
Standard form=29 No form=3 NR=9

67-Who evaluates you?
Supervisor=34 Management=4 Both=1 NR=5

68-How do you feel about your performance evaluation?

69-Is it fair?
Y=20 N=13 NR=8

70-Are you satisfied with your performance evaluation? Y=21 N=9 NR=11
If not why not?

71-For what purpose is your performance evaluation used?

For merit? Y=4

For pay increases? Y=1

For promotion? Y=11

Don't know=1
To monitor production=1
Personal knowledge=1
No purpose=19

72-How many opportunities for career development do you have?
Some=9 None=29 NR=3

SUPERVISION

73-Do you like your supervisor? Y=28 N=11 NR=6
Why?

74-Does your supervisor ever give praise on your performance?
Y=22 N=11 NR=6

75-Do you feel good when you get praised? Y=19 N=2 NR=20

76-Does your supervisor ever complain about your performance?
Y=12 N=18 NR=11

77-Do you feel bad when you are criticized?
Y=14 N=3 NR=24

78-Does the monitoring system have an influence on how you are supervised? Y=32 N=6 NR=3
If yes how?

79-Has the style of supervision changed due to monitoring?
If yes how? Y=23 N=4 NR=14

CONTENT

80-Are you satisfied with your job?
Y=29 N=9 NR=3

81-Is your job important to you? Y=32 N=3 NR=6
Why?

82-Is your job more or less important than other parts of your life?
More=4 Less=24 Equally=6 NR=7

83-Does your job make you feel good about yourself?
Y=22 N=7 NR=12

84-Do you have any control over the decisions that affect your work? Y=9 N=11 NR=14

85-How many opportunities to participate in these decisions do you have? Y=16 N=11 NR=14

86-Does the monitoring system help you to gain control over your work? Y=3 N=23 NR=15
If yes how?

87-If you could change anything in your job what would you change?

88-What do you most like about the monitoring system?
Easy to understand=1 Sharing of workload=2
Knowledge of performance=16 Better performance=2
Don't know=12 NR=8

89-What do you least like about the monitoring system?
Watching (Big Brother)=9 Unrealistic standards=6
Negative effects (pressure, low self-esteem, job more tedious)=19
Lower quality of work=6 Don't know=1

APPENDIX 3

DESCRIPTION OF THE WORKPLACES

Hospital

All medical transcriptionists and the supervisors were interviewed (on company time). The transcriptionists are fed copy by dictaphone and key copy into a computer. Most of the documents processed were short (2-3 pages long).The number of characters typed was measured by the computer. Workers were allowed to check their progress whenever they wished and had to meet a rigid standard. At the end of the work day each transcriptionist prints out her performance record (number of characters of each document + identification number of the document), writes down her actual working time (working time = number of presence hours less interruptions, such as answering phone), and files the printout in a directory. At the end of the month the supervisor computes workers' productivity (monthly and weekly) based on the information contained in the directory. Workers receive monthly feedback from the supervisor who sometimes makes comments such as: "Keep up", "Try to do better". Workers also have to meet a quality standard: less than 2% of their documents has to be returned for correction. The computer printout allows the supervisor to find who types the document returned. After a document is being returned, the supervisor has to decide whose fault it is: typing fault of the wordprocessor, bad dictaphone, modification of the physician, ...

There were no labor-management problems. The supervisors were quite happy with the present system: it facilitates sharing of the workload and helps to identify the best workers. Moreover the best workers were used by the supervisors as reference for the low performers.

The main effect of the electronic monitoring system was on skipping breaks. Workers were allowed to take two fifteen-minute breaks and one lunch break per day. But since the time for these breaks was not counted as interruptions, most of the workers did not take any break or took very short breaks. A unique feature of this wordprocessing department was a home-based component which was sanctioned by the union and management. Three workers took dictation at home, over phone lines. They were full-time workers and had to meet a rigid standard which was higher than the office standard. They were very happy with this working system and thought electronic monitoring was a necessary component of the system.

Insurance Company

The interviewed employees were doing fairly routine claims work. They had variable work standards depending on the type of claim. Problems arose with the increasing of standards which were determined by classic industrial engineering time and motion studies. Labor-management relations were very poor.

Newspaper

Classified ad takers and advisors for classified ads were interviewed. These workers deal with customers by phone and do all their work (ad retrieval, information retrieval, ad taking...) at terminals. The electronic monitoring of their performance include: eavesdropping, (in such a way that workers never know when they are being monitored), timing of length of calls, number calls per day, and lag between calls, recording of number of personal calls, and log on/log off system that records breaks or interruptions. Three times a day, computers provide workers with feedback about their calls (numbers, length, ...). At the end of the work day, a report on each worker's performance is printed out and given to the supervisor.

Workers are required to perform at specific standard, depending on the type of ads. Workers were unanimously against phone listening because it was perceived as an infringement of their privacy. A major impact of the electronic monitoring system was on their talking to fellow workers. They were authorized to get feedback on their performance only three times: this was a source of conflict between workers and management because workers wanted to get feedback at their discretion. Indeed labor-management relations were very strained, particularly because of the rapid rotation of supervisors who generally did not know the work of the subordinates. The breakdowns and slowdowns of computers -- that was a crucial problem for those employees who deal with customers -- was another source of stress, since work standards were fixed and did not take into account technological problems. Finally there was much resentment of the entire monitoring system.

Telephone Company

Service operators and long-distance operators were interviewed. All the work was done at terminals. These workers have been monitored for a long time (eavesdropping). Computer technology allows for more monitoring: length of calls and number of calls are directly recorded by the computer. The operators resented the work standards: on the average, each call must take less than 22 seconds; that is operators must handled 600 calls a day. The major criticism against the standard was that it gives no time for good service. This was a crucial problem because most of the customers need help (elderly people,...). Although direct supervisors were well liked, workers feel pressured to work faster and faster. Besides operators receive feedback on their performance from the supervisor only when there is a problem, that is when the standard is not reached. Labor-management relations were very strained.

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Social Aspects of Changes in Worker Monitoring and Computer/Communications Privacy and Security Practices*

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EXECUTIVE SUMMARY

The monitoring of workers is emerging as a symbol of the uses and potential abuses of technology. At one and the same time, monitoring is a means to locate workers committing fraud and a tool which can create onerous surveillance upon trustworthy employees.

OTA was requested by the Congress to analyze the monitoring of Federal employees' use of telecommunications and computers. This contractor report is one of a number of reports investigating that topic. The approach taken for this particular paper was to first consider the broader environment and context within which monitoring occurs. The monitoring of information technology systems is part of a large setting and group of issues. A "funnel-like" approach to the issue was taken, moving from very general to more narrowly focused concerns. The changes with respect to privacy and monitoring in the workplace are strands of broader social trends and processes.

PRIVACY. There are serious complexities in the definition of privacy, largely stemming from changes in technology and social organization. The boundaries that traditionally defined what was public information and what was private information are shifting. A number of previously taken for granted ideas are now lacking in clarity and increasingly in dispute, as illustrated by several examples. The implications of new monitoring .pa technologies for privacy are difficult to assess because 1) privacy has a number of different meanings or dimensions 2) whether privacy is seen to be unjustly invaded varies depending n factors such as the geographical and social setting (thus the same behavior may have very different meaning depending on the context) 3) recent changes in monitoring technology and social organization have thrown traditional definitions and boundaries into a state of flux and there is neither legal, nor popular, consensus regarding many privacy issues. As revealed by the paradoxes involved in monitoring, policy solutions which attempt to rebalance privacy rights will be difficult to establish. These points were discussed in Section 1 of this report.

In any discussion of privacy and worker monitoring, the legal and technical aspects must be supplemented by consideration of the sociological. Such consideration makes it clear that just because something *can* be done from a technical and legal tandpoint, it does not mean that it *should* be done, or will be sound social policy. Six general sociological ideas are briefly discussed which can help us understand the social setting within which monitoring occurs: 1) privacy and monitoring involve questions of power 2) in a bureaucratic setting there is often a tendency for new technical means to determine ends 3) surveillance techniques are often expansionary with respect to both the resources they use and the domains they cover 4) control in organizations is always limited and to a degree depends on the cooperation of the controlled 5) organizational environments are dynamic --interventions are never cost free, and often bring unintended consequences a) in adversarial work environments mployees may react back in efforts to neutralize monitoring b) solving one problem sometimes brings another. The cure can be worse than the disease. 6) more information is not necessarily better. This was discussed in Section 2 of this report.

MONITORING TECHNOLOGIES. Monitoring technologies were reviewed and illustrations were given of several of the complexities involved in evaluating whether privacy is affected by their uses. The dual nature of technology is such that it can increase as well as decrease privacy; to penetrate traditional walls protecting an individual's privacy as well as to create new and stronger protective walls. Indications of how technology can be used to protect privacy were discussed and specific aspects of monitoring were provided, including the analysis of a case study of one monitoring investigation of Federal employees. Criteria to evaluate the privacy implications of technologies were presented in the final part of Section 3.

WORKER MONITORING PRACTICES. Worker monitoring means different things to different people, as illustrated in Section 4 of this report. While monitoring of workers is certainly not a new phenomena, its current forms cover a broader area of actions, is more finely tuned and more intensive, and allows current as well as retrospective reviews. There is a serious gap in research on the topic and contemporary worker monitoring is not well understood. There are a number of conditions which contribute to the uses of monitoring, such as changes in the workplace, management oversight requirements, technological capabilities and economies of scale, changes in the nature of work and the work force, preventive aspects of management, and public opinion. There are other factors which discourage or limit the use of monitoring of workers. These relate to laws, alternative technologies, labor-management decisions, and limits to available monitoring resources. It is evident that monitoring can have major impacts on workers as well as the larger social order, although these impacts have not sufficiently well examined to date.

SCENARIOS Section 5 of this report considers two scenarios for what work monitoring might be like in the year 2005. Monitoring patterns can be drawn out by creating scenarios which reveal key ingredients. Based upon different sets of assumptions regarding information ownership, technological uses, and stakeholder power positions, two scenarios of the future were prepared. An unrestrained worker monitoring scenario provides a picture of monitoring decisions being made by management without external legal or internal employee constraints. The second scenario is a scenario where worker monitoring is structured around worker-management negotiations, with monitoring considerations being structured by monitoring impacts on employee work life, productivity, and other features of the work environment.

RELATIONSHIPS BETWEEN PRIVACY AND SECURITY. Section 6 of this report was written in order to provide OTA with a review of the relationships between security and privacy. From an examination of the problems involved in attaining both privacy and security, a discussion was presented on how current information security changes in the Federal Government may have a negative impact on privacy protections. A number of factors have been suggested which could contribute to increased privacy protection. The future, while filled with great activity in information security, may hold less privacy assistance unless concerted efforts are made to increase the importance of privacy to the Government as well as the private sector.

POLICY IMPLICATIONS. The Congress can become more involved in focusing the development of technologies in support of privacy. More specifically, the last section of this report contains policy suggestions on how Congressional activities could provide some balance between the extremes of letting any and all technological worker monitoring occur in a laissez faire fashion and attempts to prohibit all forms of worker monitoring. Interest groups of course disagree about where (and even if) a line should be drawn. Yet Congress can support what our legal system and culture suggests-- that when monitoring is done that it be done, to the extent possible, in an appropriate fashion. In that regard, the Congress can become instrumental in establishing protections against improper monitoring, establishing standards for monitoring, supporting research on monitoring, reviewing privacy protections, establishing mechanisms for privacy protections, coordinating and integrating privacy and information security, and supporting the development of technical protections.

I. GENERAL PRIVACY DEFINITIONS, ISSUES AND TRENDS

Examples of New Privacy Issues in the Workplace

Privacy has always been a difficult concept to apply. As we will note, it has multiple and even conflicting meanings. The same behavior may be viewed differently depending on the context. Recent changes in technology and social organization have increased this difficulty of definition.

Changes in monitoring technology, work technology, and the location of work are forcing a redefinition and rethinking of basic issues. A number of questions are in flux. As illustrations of the problematic aspects of monitoring, consider the following cases, some actual and others hypothetical:

* A random check of a secretary's microcomputer finds a file of personal letters and a program for preparing income tax forms. The employee is warned to only use the company's computer for company business. The employee disagrees and feels her privacy has been invaded and her freedom of action inhibited, just as if the company had looked in her desk, locker, or purse and told her what she could or could not have there.

* Analysis of the productivity of data entry workers reveals a decline between 3-4 in the afternoon on the part of mothers of school age children. Further investigation also reveals a marked increase in phone usage at this time. The explanation was simple --mothers were calling to be sure

that their school age children arrived safely at home, or at a child-care facility. Employees were reminded of the company's policy of not using the phone for personal calls. Employees were told that the newly installed PBX phone system would create a record of all calls (in-house, local and long distance). Subsequent monitoring found that phone usage declined considerably, but managers were surprised that productivity also declined.

* Two workers leave a factory as their shift ends. They walk across the street. They are engaged in a heated discussion and a fist fight breaks out. A video camera mounted in the company's parking lot records the fight. The employees are subsequently fired. They claim their activity outside the factory gates was a private matter. A judge agrees and orders that they be rehired.

* An experienced telephone operator was fired for spending "too much time" with callers. She averaged 33 seconds per call (3 seconds over the productivity standard). In her own defense, the operator said she exceeded the average because she refused to cut off people who have trouble with the English language or those who are hard of hearing. After a well publicized struggle she was reinstated.

* A toxic drug screen suggests that an employee recently used marijuana. The employee is told he must go through a drug rehabilitation program and will be fired if a future test has the same results. The employee does not deny using

the drug, but indicates it was used at a weekend party several weeks previously. He claims that as long as he functions well on the job, his off duty activities in the privacy of his home should not be subjected to monitoring at work. He also claims that it is an invasion of his privacy to force him to take such a test.

* A well qualified job applicant with positive views toward unions and a history of political activism is denied employment. The company denying him employment has been a frequent target of union organizing efforts. The initial screening of the employee involved a polygraph and paper and pencil tests in which questions were asked about attitudes toward politics and unions. The applicant also believes that his name was checked against several private data bases maintained by companies which sell information on political activists and union activities. The applicant does not claim that the information the employer has about him is wrong, but argues that it should be irrelevant to a hiring decision.

* Persons working at home as part of a company's telecommuting program, find that their use of the company's computer and telephone in their home can be monitored without their knowledge. They claim this is an invasion of privacy, since it comes right into their home. The company disagrees and sees it as a natural extension of their need to supervise.

* Hidden microphones are found in the bathrooms of a large manufacturer. A union grievance is filed claiming that this violates a basic privacy right. Management defends the action, claiming they are concerned about drug sales and use at work.

* An efficiency expert convinces the owner of a rapidly expanding family business that productivity would be enhanced if internal communications patterns were analyzed. Records are analyzed indicating who telephones who, when, and for how long. The content of a sample of calls is also analyzed. This research coincided with a unionization drive. Union organizers claimed the action was invasive and violated their right to free speech and association and made it much more difficult to organize. Management claimed that its only concern was efficiency and that matters pertaining to the organizing drive were ignored.

* All employees of a large food processing firm are required to undergo a blood test for AIDS. Several are found to be carriers of the AIDS virus, although they have not actually developed the disease. They are put on administrative leave. Their salary continues to be paid, but they are told not to come to work. Beyond concern about having this confidential information on their personnel records, the employees feel discriminated against and humiliated. They ask that they be judged on the basis of their work, not as a member of a risk category.

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* Female employees working in a chemical processing plant are required to submit a monthly sample of saliva. This is analyzed to determine pregnancy. Since pregnant females stand a greater chance of developing certain health problems when exposed to the chemicals used at the factory, anyone found to be pregnant is at once transferred from manufacturing to clerical work. Employees claim that their privacy is invaded. They view pregnancy as a personal matter and claim that information about it should be in their direct control. While they are aware of the risk, most pregnant females do not develop the health problems in question and they wish to be able to choose where they work.

* As part of a plan to increase productivity and control physical access, a data processing firm adopts a card security system which requires checking in and out of various work stations. This even extends to bathrooms. Employees view this as unnecessarily intrusive and demeaning. A computer program is used which flags atypical behavior (e.g. those whose number of trips, or aggregated time spent in the bathroom exceeds the average). Unfortunately, the program cannot separate out those whose behavior is a response to stomach flu and other illnesses from those who are malingering. The employee's association argues that judgements should be made on the basis of an employee's actual job performance. Management claims staying within the time allotted for breaks from work is a part of performance.

* In a large manufacturing firm, the vehicles used by sales, repair and delivery persons whose work involves travel to client sites (rather than being carried out within a fixed locale such as an office or factory setting) are fitted with radio transmitters. These send a signal to a central computer which then graphs the vehicle's location and displays it on a screen. Supervisors see the system as a great boon to productivity and acocuntability, since they now have a way to know where there employees are. It can also serve as an anti-highjacking device. The employees, accustomed to the greater self-pacing and discretion that they traditionally had claim the new system invades their privacy and that they should be judged by results, not by where they are every minute of the work day.

* Under the provisions of National Security Decision Directive 196, and in response to concern over leaks to the news media and security more generally, a Government agency requires all of its employees to submit to polygraph tests and begins intensive monitoring of telephone usage. A computer program is written which, among other things, compares calls made against a list of phone numbers of "special interest". Included on this list are the office and home phone numbers of a number of investigative reporters known for writing stories critical of Government.

These examples suggest a blurring of lines which in the past were taken for granted, or simply not seen, or contested. This can be seen with respect to distinctions between:

1) what is considered as on and off work duty behavior

2) what is considered as personal and employer property

3) behavior which may be accepted informally as part of the compensation for work (personal "perqs" such as pens, paper, and some phonecalls) and what, in a legal sense, actually belongs to the employer

4) what an employee can control and keep to him or herself (whether a choice of how, when, and whether to be observed via video, audio or electronic, biomedical, and other sensing means) and what the employer has a right to know.

What has been suggested from the discussion to this point is that traditional views of privacy may be inadequate for evaluating new technological aspects.

Types of Privacy

Privacy is not a simple concept with only one meaning. A variety of definitions and uses of the term can be identified. Common to these is some boundary, line, or sphere which, when it is crossed, leads us to see an invasion of privacy. The literature [Warren and Brandeis, Westin, Ware, Bok, Greenwald, Rule et al, National Commission on Privacy, Fried, G. Marx, Schoenman, Moore, Stinchcombe] suggests at least six distinct meanings:

1) an expectation that current behavior will not be observed, overheard, measured, monitored or recorded without notice and consent the individual.

2) an expectation that one will not have to divulge personal information (whether involving past or current activities, beliefs, experiences or social, psychological, or physiological characteristics and attributes) absent direct relevance to the issue at hand.

3) an expectation that information you divulge, activities you engage in with friends or certain professionals (doctors, lawyers, religous counselors) will be treated confidentially

4) an expectation that information you divulge to organizations (whether governmental or private) will be protected and not used in ways you did not intend nor shared with third parties if you do not consent.

5) an expectation that one will be left alone. Of course this is implicit to the above, but what is of interest here is not having others intrude into your space with things like loud music or smoking. This is different from the above because rather than something being taken away that is yours (a visual image, your words, information on your past, a search), something is added,introduced, or forced upon you that you don't want.

6) Finally let us note a related right to know about data that pertains to one's self. This more contemporary emphasis has gained in significance in recent decades, as large organizations have come to hold more and more information on

individuals (some of which is willingly provided but much is gathered without their knowledge or explicit consent). In a strict sense this is not a question of individual privacy, since it assumes that personal information will be given up, rather than withheld. Yet as with the first five meanings, what is more generally at stake is the individual's control over personal information and its impact on his or her life. Control can refer both to whom you choose to share the information with and to the right to have access to information about yourself and to have that information be accurate. In the case of violations of the more traditional forms of privacy, a barrier is crossed against a person's will. In the case of withholding information, a person is denied something her or she are entitled to.

Workplace privacy may involve all of the above, but with respect to work monitoring, issues are most likely to arise in the case of observation (#1), personal revelation (#2) and the fairness, due process, and notice questions around accesss to information collected on the person (#6). As we note in upcoming sections, changes in technology have made it possible for employers to vastly expand the amount and kind of information that can be gathered on employees.

Legitimate Expectations of Privacy Depend on the Context

There is disagreement about privacy issues because the above do not necessarily cohere in neat packages. Real world situations often contain contradictory elements. Three examples of the complexities involved in determining privacy rights are:

- the privacy rights of different individuals or group may be in conflict, such as an employee's right to keep personal health data private vs. an employer's interest in knowing about conditions that may affect peformance, health insurance costs and liability
- an employee's right to know about hazardous conditions at work may conflict with an employer's right to protect proprietary information
- an adopted person's "right to know" about the identity of their biological parents vs. the latter's right to keep that private if they wish

The issue becomes even more complicated because, whether or not invasive behavior or the withholding of information is seen as legitimate depends to an important degree on the specific context and conditions. A supervisor watching and listening to employees on an assembly line is not questioned, while using a hidden camera and bug to gather equivalent data from an employee lounge would be. Authorites cannot pump or cut open a person's stomach to look for drugs, but surgery for the removal of an appendix is allowable. The same behavior can be seen as appropriate, or an illegitimate invasion of privacy, depending on its purpose, whether it occurs on a public street or in a home, and/or whether a judicial warrant has been issued. In a quite specific legal or moral sense, privacy may be invaded because a barrier is crossed, yet whether or not this is viewed as an "invasion" depends not so much on the behavior, per se, but on its broader context. There are few, if any, forms of privacy invasion that all persons would agree are always illegitimate.

The Changing Nature of Privacy

To make matters even more confusing, beyond enduring value conflicts, some of our basic concepts are changing and new ones are needed. As the workplace examples above suggest, many of today's privacy issues are unlike those of the past. Even if we can agree on the broad principles that should guide us, there is a lack of clarity about when and where these should be applied and about what ought to be protected.

An indication of how much privacy and related concepts have changed over the years is shown in Chart 1. With the cooperation of the Library of Congress' Congressional Research Service, the Library's subject catalog was searched from 1965 until the present. The subject catlog listings provide a means of charting changes in the public uses of certain concepts. As indicated in the chart, there have been major expansions in what these terms cover. Particularly interesting are the changes found since the establishment of the Privacy Act of 1974. An equivalent pattern can be noted when an analysis of articles in the Reader's Guide to Periodicals is carried out.

CHART 1

CHANGES IN PRIVACY AND RELATED TERMS SINCE 1965

[Information to be added from search of THE LIBRARY OF CONGRESS CATALOG LISTING (1965-1985)]

Technical developments are forcing a reexamination of things that in the past were not questioned. Some of the traditional physical protections for privacy have become irrelevant, or at least less protective, in the face of powerful new technologies.

It is unclear how new workplace technologies ought to be viewed. The boundary between acceptable behavior and the invasion of privacy is increasingly dynamic, rather than reflecting a clearly drawn line. This contrasts with the sureveillance capabilities of a less technological age when a "reasonable expectation of privacy" was defined partly by what the unaided senses were capable of doing and when physical location and other barriers offered greater limits to the gathering of information.

There is no clear right or wrong answer and values may conflict. But describing what is happening and what is at stake is necessary for better informed public decisions.

Why Privacy is Important

From a social psychological perspective, privacy is an essential component of individual autonomy and dignity. Our sense of liberty is partly defined by the ability to control our own lives --whether this be the kind of work we undertake, whom we choose to associate with, where we live, the kind of religious and political beliefs we hold and actions we take, or the information we wish to divulge about our selves.

The latter is particularly important for our sense of self and our self-respect. When an individual's room, pocketbook, or body can be searched at will, when conversations and even thoughts are available for instant inspection by outsiders, openess and honesty lose their meaning. The ability to share and withhold information is an important resource. It is a building block of friendship and also of economic activity.

Privacy is also an essential component of social organization. The integrity of a group depends on its boundaries being protected from non-group members. When all that a group does is available to outsiders it is strategically disadvantaged. It's sense of solidarity and membership are partly based on sharing information, and on behavior that "belongs" to the group and is not immediately known to outsiders. We value privacy not because we wish to encourage illegality or ineffeciency (although these may sometimes accompany it) but because many of our most cherished notions, --our idea of individual personality and dignity and a pluralistic democratic social order made up of autonomous groups require that there be limits on the crossing of boundaries.

As this discussion has indicated, the concept of privacy has become more complex and is undergoing important changes. In order to better understand this let us consider some general sociological perspectives in the next section.

Summary

The implications of new monitoring technologies for privacy are difficult to assess because 1) privacy has a number of different meanings or dimensions 2) whether privacy is seen to be unjustly invaded varies, depending on factors such as the geographical and social setting (thus the same behavior may have very different meaning depending on the context) 3) recent changes in monitoring technology and social organization have thrown traditional definitions and boundaries into a state of flux and there is neither legal, nor popular, consensus regarding many privacy issues. Privacy is important because it is a central component of individual and group autonomy. Liberty is partly dependent on the ability to control personal information.

II. SOCIOLOGICAL PERSPECTIVES

Non-Legalistic and Non-Technical Aspects

Privacy and work monitoring questions are most often approached as either legal or technical matters. The former focuses on the legality of various practices judged with respect to the U.S. and state Constitutions, statutes and court decisions and on whether new laws are needed. The latter looks at the cost and effectiveness of the technology and at technical counter-means. A predominently legalistic or technical type of discussion tends to overshadow if not exclude other important aspects of privacy and security. These must be supplemented by an approach which considers the social and psychological implications for work and for organizations. [Important statements by Kling, Kling and Scacchi, Atewell and Rule, Laudon, and Perrole]

Such an approach provides other standards by which to measure appropriateness and offers basic insights into privacy-related issues. What is needed are additional ways of interpreting privacy and the development of a vocabulary which can provide means to understand new technological phenomena. While philosophy, history, and other specialties have much to offer, this report emphasizes a sociological perspective. This perspective provides information on the ways that social issues (such as privacy concerns) grow. It can also help to assess the impact of technology on society, institutions, organizations, and individuals, as well as the reverse.

Technical and legal changes have an impact upon social contexts. Yet institutions, groups and individuals are hardly neutral tableaux. They not only condition what kinds of technical and legal changes occur, they also condition their impact. Understanding the social background is essential for intelligent planning and weighing the values that may be in conflict. Awareness of social factors can lead to the realization that just because something *can* be done from a technical or legal standpoint, it does not automatically follow that it should be done on either ethical, or cost-effectiveness, grounds. Nor does it follow that it will turn out as intended.

In order to expand the public discussion of privacy and to better understand new communication technologies and their uses for monitoring of workers, let us consider some sociological perspectives.

1) **THE POWER AND POLITICS OF INFORMATION.** Privacy and monitoring are part of the relative power of individuals and organizations. There are many forms of cooperation, interdependence, and shared concerns within the workplace (e.g. a business that goes bankrupt is likely to hurt both owners and workers; it is in the interest of both to avoid accidents at work). Yet the workplace is also an arena of struggle where the interests of various groups can be opposed and where what is to the advantage of one group may be to the disadvantage of another.

Whatever else it is, the control over information regarding worker's behavior is a political issue. The technology tends to both grow out of and fit into the existing social organization. Therefore, information is likely to reproduce and sustain the existing system of stratification. The uses of technology involve a latent or actual struggle over who has the right to collect information and over how it is to be used. Information, like wages, can be seen as something subject to negotiation. Whatever the elegance of the emerging technical means of monitoring, it is important not to deny the presence of a political component. The information use practices which appear are not given in the technology, per se, but are a function of social and political choices and the political bargaining between workers and management. Scandinavian countries, where a high percentage of the work force is unionized, show a rather different pattern of worker monitoring than is the case in the U.S., where a small and declining percentage of the work force is unionized. [Swedish Embassy information]

2) **TECHNOFIX SOLUTIONS.** In a bureaucratic setting there is often a tendency for new technical means to determine ends. They may become solutions in search of problems. This is the opposite of the traditional bureaucratic model of decision-making wherein starting with the goal, rational calculation leads tothe selection of the best means. As Ken Laudon observes in discussing organizational uses of technology, "Instead of starting with goals and choosing among alternative means....actors begin with a set of policy means and instruments and ask how these can be

related to overall goals." [Laudon, forthcoming] The fact that it is possible to do something can generate a pressure to do it. To reverse a familiar phrase, where there is a technical way, there is a will. The power and novelty of the technique can lead to a search for ways to use it, rather than asking how traditional goals can best be obtained.

3) **EXPANSIONARY SURVEILLANCE.** Surveillance techniques are often expansionary with respect to both the resources they use and the domains they cover. They may make individuals and organizations hungry for ever more information, without adequate consideration of whether its collection is sound social policy and will further organizational goals.

There are many examples of this. Thus practices which begin with a national security justification may move to other sectors of Government and to the private and civilian sectors of the population (e.g. polygraphing in Government once to a large degree restricted to national security concerns is now applied to concern over leaks to the press). In justifying the use of computer dossiers, the 1974 Privacy Act was nevertheless very clear about not matchng unrelated data bases. Data could be combined only in cases of routine use. Yet as computer matching has spread rapidly to many areas [Marx and Reichman, GAO, OTA], this has been violated. The development of a large national criminal justice history information system was put forth as a means of dealing with crime, yet more than one-half of the requests for information involve employment and licence checking, not criminal investigation. [Laudon, Ibid] In creating the social security number Congress was very clear about it not becoming a national id, yet whether used on driver's licenses or library cards, it has tended to become a de facto national id. Video cameras, once largely restricted to maximum security prisons and military facilities, have become commonplace in department stores and city streets.

4) **LIMITS TO CONTROL.** Control in organizations is always limited and to a degree depends on the cooperation of the controlled. Research on "total institutions" [Goffman, McEwen], even those of a highly coercive nature such as prisons, indicate that there is something less than full control. Humans are wonderfully ingenious at finding ways to disrupt, distort and deceive monitors. Conformity to the demands of those in authority is partly "purchased" by informal agreements between controllers and controlled. (Marx, 1980) There are likely to always be niches, crannies and small spaces beyond the monitoring ability of the most powerful technologies. Authorities settle for something less than the full control they would like and hold back a bit, in return for a degree of cooperation from the controlled. Cooperation is likely to be more effective than coercion, and even if this isn't the case, the latter clearly has functional and ethical limits. To treat employees as objects to be engineered in the same way that one engineers sheet metal into fenders is a presciption for disaster for all involved.

5) **UNINTENDED CONSEQUENCES OF CONTROL PROGRAMS.** Organizational environments are dynamic and interventions are never cost free. Programs often bring unintended consequences.

In adversarial work environments, employees may react back in efforts to neutralize monitoring. A. Downs [Downs} suggests a law of counter-control wherein each effort at control is likely to result in blocking or neutralizing efforts. In fact, solving one problem sometimes brings another. The cure can be worse than the disease. For example monitoring worker's behavior in a way that is technically possible may be effective in the short run or in the sphere in question, but may trigger other undesirable consequences. The history of management's efforts to control labor, parental efforts to control children, and Governmental efforts to control drugs and alchohol indicate this point.

6) **INFORMATION COMPLICATIONS.** More information is not necessarily better. [Tumin and Moore, Marx and Reichman, Wilsnak, Wilenski]. This is an obvious point but it is frequently overlooked. While the new technologies make it easy and relatively inexpensive to collect new kinds of data, the availability of information does not automatically transfer into action. The data must be processed, protected, analyzed, interpreted and applied. When the data are to be used for processing people (e.g. hiring, re-assigning, training, rewarding, penalizing, or firing), more is not necessarily better. There is a possibility of information overload. This can lead to inaction. Reminiscent of the three monkeys who encountered no evil, there is the danger of finding out things that a manager would prefer not to know. Examples of secondary revelations include things such as the fact that checking phone records may reveal not only use of the phone for personal

reasons, but the nature of those reasons (e.g. calls to dial-a-porn, plans to leave the job soon); video surveillance of a parking lot to protect employee's cars may generate evidence of who is having an affair, as well.

Where infractions are discovered, processing them is not automatic. The system may be "flooded" such that violations are so widespread that the organization lacks the ability to act upon all of them. This can lead to a perception of discrimination on the part of those employees who are sanctioned. It can also create a new resource which management can use at its discretion. Violations may be saved until management wants to get someone. Discretion can be misused. To insure that there is due process and fair treatment will cost other resources. Of course, if the information is not reliable, costs will be even greater from law suits, bad publicity, and lowered employee morale. This has been the case with several well publicized instances involving lie detection and toxic drug screens.

SOCIOLOGICAL PERSPECTIVES AND PRIVACY IMPLICATIONS

Perspective	Privacy Implications
Information Politics	Misuse of Information
Technology Fixes	Humans Viewed as Passive Objects
Expansionary Surveillance	Overmonitoring
Limits to Control	Emphasizing Ever More Control
Unintended Consequences	Unexpected Privacy Issues
Information Complications	Due Process Problems

Summary

In any discussion of privacy and worker monitoring, the legal and technical aspects must be supplemented by consideration of the sociological. Such consideration makes it clear that just because something _can_ be done from a technical and legal standpoint, it does not mean that it _should_ be done, or will be sound social policy. Six general sociological ideas are briefly discussed which can help us understand the social setting within which monitoring occurs: 1) privacy and monitoring involve questions of power 2) in a bureaucratic setting there is often a tendency for new technical means to determine ends 3) surveillance techniques are often expansionary with respect to both the resources they use and the domains they cover 4) control in organizations is always limited and to a degree depends on the cooperation of the controlled 5) organizational environments are dynamic --interventions are never cost free, and often bring unintended consequences a) in adversarial work environments employees may react back in efforts to neutralize monitoring b) solving one problem sometimes brings another. The cure can be worse than the disease. 6) more information is not necessarily better.

III. MONITORING TECHNOLOGIES AND THE WORKPLACE

Worker monitoring raises many important issues beyond privacy. It has implications for job satisfaction, skill development and mobility, sense of control, and health. These issues are of major significance, but our concern in this report is restricted to issues of monitoring and privacy, although these other issues may be interwined.

Given their newness and continual innovation, there has been little research on how the new forms of monitoring are distributed. How prevalent are they and in what kinds of work settings are they most likely to be found? How do the practices of government at various levels differ from each other and from those in the private sector?

The intensive and extensive monitoring of telecommunications and computer usage is obviously focused mostly heavily on workers for whom use of the phone (sales and reservations agents) or computer (data entry persons) is a central feature of work. But practices here are no less important for involving a small percentage of the work force. They may be an indication of what will appear elsewhere as other work settings come to rely increasingly on computers.

Three major groups affected by privacy issues in the workplace are employees; outsiders/ clients; and managers. Each of these groups has privacy expectations and each may violate the privacy of others (e.g. hackers who break into a company's records, employees who gain access to privileged records, managers who secretly monitor employee conversations). Most considerations of privacy and computers treat the implications for customers or clients whose information is in a data bank, or the focus is on how organizational data can be protected from unauthorized access, whether by outside snoopers or internally. Our emphasis however will primarily be on the implications of managerial actions for the privacy of employees, although one factor driving the increased monitoring of employees may be a desire to protect the privacy of company information.

In this section we describe some monitoring technologies, indicate some of the ways they may invade or protect privacy and suggest some criteria by which they can be contrasted.

Description of Some Monitoring Technologies and Trends

Worker monitoring is hardly a new phenomena. The job of the supervisor has always been to watch workers. Monitoring was traditionally related to social stratification or power distribution. In general, the higher the position in the organization, the less the overt monitoring. Indeed freedom from continual and intense scrutiny can even be seen as a reward, or resource allocated to those high up in the organization (whether by those formally designated as monitors or fellow workers). Greater privacy is given as one rises in an organization, as is indicated by the availability of personal phones, separate offices, and executive dining facilities and bathrooms.

Behavior on the job (and to a degree, off the job -- particularly in company towns) has historically been subject to careful scrutiny. The architecture and social organization of the factory system sought to facilitate managerial control. With the rise of Taylorism, which divided work into very specific components with precise expectations for work quantity and quality, monitoring became more intense and supposedly scientific. But it still relied heavily on the immediate activity of the supervisor and on what was immediately visible. Monitoring was personal and workers were likely to know when they were being watched.

What then is new? Are we dealing with differences in degree or in kind? This is not easily answered and depends very much on where one looks and on one's starting values and assumptions. Continuity as well as change can be noted. In many ways, recent developments in monitoring continue the ideas of Taylorism. [Storey, Howard, Zuboff]

Managers are no longer limited to what they can immediately observe through the senses, nor are workers able to know when they are being monitored (apart from knowing that monitoring is done). Changes in work and technology mean that monitoring is increasingly done (at least initially) automatically by machines. What is monitored may not be available via the basic senses. With remote control and access, monitoring becomes even more depersonalized and can be separated from face-to-face interaction. Persons may not know when they are being watched. Monitoring has become more involuntary. It has become more "transparent" (a term applied to one characteristic of some means for monitoring computers). Some forms of monitoring are like clear glass with an invisible surveillance device imbedded therein.

Monitoring has also become decentralized. Partially as a result of that, workers may directly participate in their own monitoring. Whether or not it is a willing or conscious decision, technical devices automatically record data generated by the worker. This includes monitoring from security and processing systems, capturing voice, movement, or keystrokes.

Compare a video camera and audio recorder to the traditional watching and listening of a supervisor merely walking by. The worker likely knew when the supervisor was there and monitoring was episodic --the supervisor couldn't be everywhere. Yet the camera and recorder are omni-present and the worker can never be sure whether they are in operation, or if their results will be reviewed. "Pre-technological" monitoring by a human supervisor might sometimes mean high-handed or discriminatory treatment, but the very inefficiency and inherent limitations of such oversight gave workers a degree of private space, or breathing room, which technical means of monitoring greatly reduce. Current monitoring significantly alters the control relationship and may wreak havoc with cultural expectations about privacy.

The potential for conflict is heightened when managers introduce means of monitoring which are legal, but which conflict with workers' traditional expectations of what is fair on the job. There of course is no formal protection to whisper at work, nor to be free from observation. But most persons feel entitled to a degree of privacy in their communications at work which technology has threatened or made obsolete.

The cost of monitoring and analysis per unit of data gathered have been greatly reduced. This fact, plus the power of monitoring technologies to transcend traditional barriers to data collection, have greatly increased the breadth, depth, and amount of monitoring. The miniaturization of monitoring devices and the ability to integrate (e.g. the conversion of visual images, sound, or pressure, to machine-readable form) and easily communicate various kinds of data are also facilitative.

Monitoring is no longer restricted to a bounded geographical work setting like a factory, or an office, or to what a foreman can discover by walking around. Dispersed forms of work such as by traveling sales persons, truck drivers and those who work at home using telephones and computers can now be included by monitoring their responses to beepers and carphones. The "catchment" area extends across time (day and night, past and present), as well as geographial location. Clearly any employee using telecommunications can be subject. A simple electronic transmitter can also be used to monitor the movement of persons and vehicles far from a central office.

The work place has not become a maximum security prison, nor have we reached the Orwellian world where nothing can be concealed. Yet we are clearly moving away from the traditional human scale monitoring which was more visible, sporatic, and less probing, and which was restricted to what an identifiable observor could take in through the senses. This may bring greater equity. Monitoring can extend up, as well as down the organizational heirarchy. Video cameras, card key systems required to enter a room, and computer access codes may make demands on all who encounter them.

There are also counter-trends. Technical changes may reduce the need for monitoring workers. There may be less need to monitor employees involved in standardized, automated tasks requiring little skill and discretion. As we note in an upcoming section, some technical developments, such as those protecting data, may lessen the need for traditional monitoring and it may be possible to monitor in less intrusive ways.

In summary recent monitoring developments stand out because they make visible what was previously unseen or ignored; they pierce traditional spacial, temporal and physical boundaries amd operate at a more minute and individualized level; they are more impersonal; they rely on machines rather than human judgement; they are often at a distance from those being monitored who may not know their behavior is monitored at that moment and they make it easier and cheaper to combine, analyze, and manipulate data. Monitoring is becoming more intensive and extensive.

A Case Study of a Monitoring Investigation of Federal Employees' Use of Telephones

In the Federal Government, the GSA keeps records on certain phone services. Within Federal agencies, inspectors general have responsibility for oversight of such things as the abuse or misuse of phones and computers. It is worthwhile reviewing an actual investigation of the telephone usage of Federal Government employees. After briefly stating the facts of the monitoring, an analysis will be presented and applied to other aspects of monitoring.

In May 1984, the Office of the Inspector General of the Department of Energy initiated a study to statistically analyze the usage of the Federal Telecommunications System (FTS) long distance telephone service by employees of the Department and its contractors. The investigators were interested in quantifying the amount of abuse of the FTS long distance lines and the costs associated with such abuse, rather than identifying individual abusers. FTS usage became the focus of attention due to prior investigations in the Richland, Washington operations office, which had resulted in the indictments of twenty-nine individuals for violations of 18 U.S.C. 641, Theft of Government Property, and the recovery of almost $40,000 in fines and restitution. It was decided to determine whether this abuse constituted a pattern throughout the Department.

After reviewing a statistical sample of FTS calls from throughout the Department, it was estimated that over 30 percent of the telephone calls placed on long distance FTS lines were made for personal reasons, resulting in FTS service charges of over $8 million annually in fiscal years 1983 and 1984. Wages paid to employees while they made personal long distance telephone calls was estimated at over $5.7 million in each of those fiscal years. Overall, the study concluded that FTS abuse cost the Department over $28 million.

On its face, this investigation by DOE appears to be an appropriate use of records to review workers' misuse of telephone equipment and worktime. The investigation was decided upon when a review of a DOE office revealed abuses, resulting in indictments. This suggested that there may have been a Department-wide pattern of abuse. The investigators from the IG Office were careful to examine patterns of use and to avoid identifying individual abusers. A scientific sample of Departmental calls was designed and gathered. From that sample, calls were made to the numbers called to determine whether there was a work-related reason for the calls. After categorizing the findings, the abuse pattern was quantified and recommendations were made to DOE management as to the means for controlling the problem.

Yet, there are a number of important issues which are raised by this investigation. This investigation can serve as a case study of some of the problematic aspects of worker monitoring, revealing many of the complexities involved in ensuring privacy while also protecting the legitimate needs of the Government. Major problematic issues raised by the DOE study are:

1. UNDERLYING REASONS FOR REVIEW.

The public "official" reason for instituting monitoring may be less important than the other reasons for generating investigations. In an information-rich environment, there are great possibilities for establishing projects which are based upon as well as flow from data. There are a variety of turf issues involved in deciding upon investigations, part of which deals with the "politics of crime control." In the following quote, the public "official" reason for the investigation is given in logical terms which easily justify an enlarged Department-wide investigation.

> "Our observations on FTS usage in the Richland facilities, both as to the breadth of FTS abuse and as the salutary effect of publicity accompanying the indictments, led us to conclude that we should examine FTS usage throughout the Department. Accordingly, in May 1984, we initiated a study by which we hoped to reliably estimate the extent of abuse throughout the entire Department, THEREBY FOCUSING MANAGEMENT ATTENTION ON THIS COSTLY PROBLEM." (pp. 6-7, emphasis added)

Note the end of this paragraph, where an underlying and potentially more important organizational reason for the investigation is presented. It may well be that even more bureaucratic reasons for monitoring are driving the interest to undertake the investigation.

2. LIMITING ALTERNATIVE SOLUTIONS OTHER THAN MONITORING.

It is possible that the monitoring investigation was not even necessary in order to "fix" the (potential) problem. The extensive IG review may have been necessary in order to establish a cost level estimate for the abuse which could be used as a factor in a cost-benefit analysis of possible solutions. Yet, maybe the Government could have saved itself the cost of the IG study by providing a "positive control of facilities and focus...on authorized use rather than abuse." [DOE] This positive control may have been possible without a monitoring review, although the investigation served as a means of getting managers' attention as noted above. This is even more so the case since, as the report indicates in several places, the announcement of an investigation apparently lowered telephone usage quite directly. An announcement of an investigation may have been the most cost-effective means of limiting abuse.

Ironically, the abuse problem can be traced to an earlier economic/technical attempt at a solution. "We believe that the current FTS network operation fosters abuse. Prior to GSA implementation of automatic off-net calling capabilities on its CCSA (common control switching arrangments) switches nationwide, off-net calls were `policed' through the manual efforts of operators. The objective to reduce system costs by replacing the labor intensive GSA operators with machine controlled capabilities did, in fact, reduce network costs to the Government as a whole, but it also decentralized the responsiblity to control abuse among the Federal agencies. This new decentralized responsibility has been recognized and defined, and the authority to enforce regulations and implement corrective action has been relegated within the DOE." [Report, p. 2]

Particularly interesting is the report's acknowledgement of alternative ways to control telephone abuse. Management solutions which do not require PBX type of equipment are noted on p. 4, indicating that management needs to review FTS lines and reasses the need of office and employees for unrestricted access to FTS lines. Other available measures in addition to monitoring are covered in the Appendix (pages 2-5), which contains the response by the Director of Administration.

While complications are appropriately raised for the lternatives mentioned, there are no complications or difficulties raised concerning monitoring efforts. This may lead some to assume that the monitoring option is not complicated or complex, making it by default the best measure for controlling worker abuse of telephones.

3. DIFFICULTIES IN DEFINING AND MEASURING THE ABUSE PROBLEM.

Relatively little mention is presented in the DOE report on how the calls were placed into the category of personal calls. The investigators called the phone numbers which had originally gotten the call from an employee but this investigative method leaves a lot of room for interpretation as to whether a call was personal or not. While there most likely were a number of calls which were personal, many judgements had to be made by reviewers. ertain calls quite likely were entirely personal, others were personal but required information or action (baby sitter or nursery pick up problems of single parent workers), and certain others may not have been personal but could not be certified as "unabusive". Note that the statistical table in Appendix C contains quite a number of unresolved calls.

For example, Chicago had 602 minutes which were unresolved, which were almost equal to business call minutes and much more than personal calls. It is not clear whether these unresolved calls were calls which could not be put into abuse or non-abuse categories or simply were calls where someone on the recieving end of the call could not be reached for verification. All of this is to point up the fact that social interpretation is assumed to be as accurate as is the technological ability to find abusive uses of telephones. Apparently, neither the social interpretation nor the technological ability function quite in the scientific manner which some assume.

The cost of the calls as measured by the time lost to the Government by employees not performing their work duties, as shown on pgs. 3, 12, and 13 of the report, is a prime example of how the need to quantify information turns into inappropriate "number magic" which is useful for bureaucratic justification purposes. The assumption behind the numbers is that time used to make non-DOE telephone calls can be costed out as time away from performing work. Clearly, not every worker works every minute of their workday. To cost out minutes of telephone use at the same rate as minutes of work salaries is abusing the logic of accounting.

An additional measurement problem is that the survey reviewed calls placed in December. In the reply to the Inspector General, the Directorate of Administration in the Office of Computer Services and Telecommunications Management criticizes this, indicating that December is not a typical month and calling into question the generalizability of the findings.

4. INCREASED POTENTIAL FOR OVERUSE OF MONITORING.

The report reveals that 76% of the calls were placed on telephones connected with only four out of the seventeen Department sites reviewed. (Some sites were not reviewed for a variety of reasons mentioned in the report.) That is, three fourths of the calls were from less than one fourth of the sites. As often happens, a few people at a few sites are the real problem but the solution or the means to control the actions of these individuals involves more innocent people than guilty people.

Even given this view that the problem of telephone abuse is a problem with certain locations and characteristic abuse patterns, monitoring of telephone usage and potentially other work-related uses may actually increase as a result of this study. The raw data for the investigation come from the GSA, as part of its Automated Message Accounting System (AMA). This system records only every fifth telephone call, although it is not clear from the report whether calls themselves or the numbers called are recorded. This call recording system continues to function for legitimate cost accounting reasons. Investigations similar to the DOE investigation can easily be established using the same data. Further, the data collected can easily be applied to individual employees, which was a decision consciously not made by DOE but quite possible using their data, methodology, and other techniques.

5. UNINTENDED CONSEQUENCES OF THE MONITORING.

Note should be made of the unintended consequences of the investigation and the proposed solutions. As often happens with attempts to control behavior, the response of employees may not be as malleable or predictable as thought by those who established the control mechanism. For example, it is quite possible that certain legitimate job-related calls were put off and, after employees learn the cut-off points over which calls were monitored, complicated cases may have been avoided or given less than adequate attention. This may mean a lowering of willingness to call or respond to the public. Ironically, restricting employees' abilities to make local calls may cost the Government more if employees have to leave their job sites to go to a payphone to make their calls.

In summary, there are important reasons to consider this DOE investigation as one of the better designed and developed investiations of its kind. At the same time, serious questions can be raised and need answering if this monitoring technique is to be useful for the Government as both a fraud and privacy effort.

Examples of Monitoring Technology

It is difficult to separate out the monitoring capabilities of technologies from other aspects of technical operations. Our concentration in this report is on telephone monitoring and monitoring of computer operations. Each form of monitoring will be discussed in turn.

Telephones

With the enormous changes in the communications field, telephone cost and call management have become of concern to managers in Government and the private sector. There are two major approaches which have been developed for these purposes. The first is determining the least expensive way to place a call, which is associated with least-cost routing (LCR) techniques with intelligent telephone switches and the purchase of common carriers offering pricing advantages over traditional services. The second is station message detail recording (SMDR), which records on what instrument a call was made, what access code was used, where the call went, and how long it lasted. Telephone billing systems process the SMDR information and generate detailed reports that management can use for cost allocation and cost control.

The following information on SMDR systems was analyzed with permission from the copyrighted Auerbach Publishing Company, TELECOMM MANAGEMENT, Telephone Cost & Call Management Series, 1986.

SMDR features are available as an integral part of some of the newer PBX systems or in a separate hardware/software system that works with a PBX. Call accounting systems can be added to a telephone system by purchase of a standalone system with a dedicated computer, purchase or development of call accounting software, or contracting the work out to a service bureau. SMDR systems are sometimes referred to as automatic identification of outward dialing (AIOD) or call detail recording (CDR) systems.

The kinds of telephone abuse often cited as indicating the need for monitoring include:

* Many calls exceeding the average time taken by similar employees
* Dial-it or 900-exchange calls appearing on toll bills
* Toll calls made after official business hours
* Message unit increases for which there does not appear to be business-related reasons for the increase
* Many calls during lunch hour

Among the data that can be collected by SMDR systems for each call are:

- input port
- output port
- first-choice facility
- facility used
- data/time stamp
- queue stamp
- call duration
- user authorization code
- dialed number
- call sequence number

These data can then be processed into management reports on calls by extension, costs by department, calls by time of day, calls by geographical destination, facilities usage, call summary by length of time, and other interpretive reports.

The Auerbach Telecommunications Software Specifications Directory suggests that there are currently at least 3000 installations of SMDR systems in the U. S. The number is probably somewhat larger. Such systems are likely to become much more pervasisve. As one executive put it, "communications performance monitoring is going to be one of the major computer service fields in 5-10 years." [Questronics Inc. Advertisement featuring their line of Data Communications Network Performance Products. The quote is from Wayne Embry, Technical Manager, Trans World Airlines, Kansas City, Missouri]

Computers

The monitoring of computer usage, whether mainframe, mini or micro, has two major sources. The first is information security, which views monitoring and surveillance as basic aspects of computer crime prevention. The second source is auditing, which has established a variety of EDP/ADP auditing packages and approaches.

Monitoring of computer uses has been a part of information processing since the early computers. Typical reports normally generated by computer systems are:

* Computer operator console logs
* Machine room access logs
* Processing schedules (run books)
* Computer utilization summaries
* Computer utiization accounting control reports
* Valid job order lists
* Accounting code error listing
* Terminal usage reports

Among the specific reasons ofen cited for requiring monitoring is a recognition that the system security features themselves may not be able to prevent unathorized access. There is a need to establish a review of user access and other traffic information. This may allow a real-time prevention of an unauthorized penetration of data files or an after-the-fact review of audit trails to establish patterns of unauthorized activities.

The enormous amount of information which could be collected require security and auditing personnel to be selective in their decisions as to what to monitor. Certain key indicators tend to be chosen. These include:

- Increased number of unsuccessful attempts to log-on system
- Increased number of system shutdowns
- Failures of hardware or software security mechanisms
- Attempts by unauthorized persons to access secured files
- Attempts to use privileged instructions improperly
- Dial-up traffic to host computers

Certain persons who are suspected or otherwise targeted for monitoring might well have all of their activities recorded and reviewed. This can include all aspects of their work from logging-on through all data and file changes to their treatment of security and management procedures.

More recently, the ability to monitor computer users has increased. New biometric identification and authentication products provide an increased ability to identify a user and to create a fuller file of their computer activites. Beyond this, there are new and more powerful software security tools which allow for different forms of monitoring. One product now on the market allows management or security personnel to observe, document, and restrict the activities of any user on the system. All input entered by the monitored user and all output from the computer to the user's terminal is able to be displayed on the observer's screen exactly as it occurs. All monitored activity is also captured in a log file, "creating a certifiable record to be used for disciplinary or legal proceedings." [Clyde Digital

Systems, Inc. material describing its security tool CONTRL] The security software does not affect the job being run on the monitored terminal and will capture a terminal in any status. The monitoring can be hidden from the user. The observer also has interactive control of what the monitored user enters and may terminate any unauthorized activity simply by logging off the offending user. [Clyde]

Monitoring Technologies Can Invade or Protect Privacy

Technology can protect privacy, as well as invade it. Because monitoring technologies are so penetrating, inexpensive, and low in visibility, they can be very invasive. Since this invasive aspect has been raised in other sections of this report, our focus here is on how technology can protect privacy.

Must monitoring always mean the invasion of some aspect of privacy? Can the technology which brings us monitoring also be used to lessen the need for monitoring and to protect privacy? Monitoring in some ways is an admission of potential system failure. One watches because things can go wrong. The privacy of those who are watched may be invaded, although ironically at times this is to ensure that the monitored are respecting the privacy of those whose data they have access to. Sometimes this need can be avoided by structuring situations such that attempts are made to have violations, abuses, errors, and mistakes be almost impossible. Technology then enhances privacy directly. When information systems are made more secure, invasions of privacy by interlopers are prevented or made much more difficult. Privacy may also be indirectly enhanced by reducing the need to monitor those using these systems. As noted above, technologies also differ in the extent to which they may invade privacy. Just as Pool [Pool] has noted that new communications technologies can enhance freedom, so too may certain technologies be used to enhance privacy, protect privacy, or minimize the nature of an intrusion.

1) **In Making "Leaky" Records and Communications More Secure, Technology May Reduce the Need for Traditional Forms of Monitoring.** Fiber optic lines, encryption, transformed data, and other security protections can protect privacy. For example, contrast the greater difficulty of access to records in a computer protected by encryption with the easier access that was possible when records were in a desk drawer or file cabinet. A related example is the design of telephones such that only local area calls can be made, eliminating the need to monitor for long distance abuses. In the next decades widespread ISDN may mean more comprehensive and standardized use of digital protection techniques such as encryption and authentication.

In addition, the development of "smart cards" containing personal data and carried by each individual might lessen the need to monitor for invasions of privacy and inappropriate data dissemination. This technology may help return us to an earlier and simpler time period when personal data was in the possession and control of the individual, rather than the large organization.

2) **Technological Monitoring May Be Less Intrusive Than Direct Human Monitoring.** Contrast the electronic monitoring of hand luggage at an airport with a direct search of a person's purse. The use of electronic markers on library books or consumer goods obviate the need for a physical search. If a person is concealing something, an alarm will go off as they exit. Monitoring is still going on, yet in a less intrusive form.

The development of access keys or codes for using things such as computers or copying machines may introduce greater accountability and reduce the need for visual surveillance. Thus some photocopying machines can only be activated by using an "autotron" which automatically generates a record of the number of copies made. In many office settings, before the development of this system, supervisors had to watch who was using the machine and in some cases even resorted to a system of informers to locate abusers.

Where once telephone company staff had to listen to conversations in order to check certain line conditions, technical developments have made it possible to do this without the interception of voice communication. Even computer searches can be less intrusive than a manual search. For example, a computer match of two data bases will only call up specific records of interest once some standard has been met. In contrast before the advent of computers, a human had to monitor a large amount of unrelated material to find what was sought.

3) **The Technologies That Invade Privacy May Have Other Positive Benefits For Employees.** Assuming accuracy, monitoring can protect people's rights and contribute to due process and fairness. The permanent and presumably valid records from monitoring can protect the innocent from false accusations and offer documentation of violations on the part of the guilty. Monitoring can mean a more equitable and fair reward system. Those who conform to company rules and standards can be rewarded.

Indeed, forms of monitoring can protect employees. Video and audio recordings might enhance the safety and security of workers, (e.g. video cameras in the parking lot may deter theft from cars and vandalism, video and audio recordings might lessen sexual harrassment, toxic drug screens may prevent accidents and protect employee health). Even electronic funds transfer, which allows the direct deposit of employee checks while also the potential to be used to monitor employee accounts, may enhance employees' safety and security from robbery.

Card security systems which can lessen privacy by providing an indication of where a person always is, can also monitor possible health and safety problems. Thus, an employee who enters a parking area, but does not then enter a building, or someone who enters but does not leave a bathroom may have a health emergency. The system can be programmed to give an alert after a specified amount of time passes.

Some Criteria for Comparing Monitoring Technologies

Monitoring devices differ from each other and even the same device may be applied in different ways. Let us note some complications in establishing criteria for systematic comparisons among types of monitoring which affect privacy. Combining the technical features of monitoring with the control usages of the monitoring devices, the following issues are major considerations in evaluating privacy protections.

There is the issue of primary versus secondary monitoring. Is the monitoring a direct part of the work process/product as with monitoring phone behavior of telephone operators or reservation clerks, or is it something that is added on and apart from the work process, such as a drug screen? Does the monitoring directly relate to the production process as on an auto or other assembly line or, is it more derivative, indirect, or secondary, as with controlling and recording access to a place or information or video cameras in a hallway.

A second issue relates to the goal of monitoring. Some possible goals are: to measure performance quantity/quality, to discover violations, to deter, to restrict access, and to protect the company or worker. Goals of course may be mixed and hard to determine and perceptions may vary. Thus drug screens and health screens more generally can be seen as protecting the worker against illness, sick days, medical expenses, accidents etc., yet they can also be seen as interferring with an employee's life style.

A third related issue is use of the monitoring. Is monitoring used to punish or to terminate questionable workers, or those who management predicts will likely get sick or have problems? Is it used to reward effective performers or to retrain those whose performance is weak? Is it used to evaluate groups rather than individuals as such (e.g. using only group averages, not individual data). Is it "used" at all in any direct sense, rather than serving as a scare-a-crow or as a tool for general intelligence and the overall understanding of system operations.

A fourth issue concerns whether what is monitored or controlled is access to a building, room, data base, and/or what you do once you are there. There is a difference between encryption, voice, touch typingor retinal pattern access and devices which record what you actually enter in, take out, or say once you have access. The former involves monitoring the transaction's occurence, while the latter involves keeping a record of what actually was done. The former are often used as security and preventive devices to keep unauthorized persons out of the system, rather than to monitor authorized users.

A fifth issue involves fairness as a tradeoff for loss of some privacy. Thus a positive finding on the inexpensive EMIT drug test must be followed by a more complicated and expensive test vs. a video and audio record of drug sales or an alarm going off if someone tries to take an expensive tool with an embedded sensor out of the workshop. For example, you may have an accurate measure about how long on the average a phone operator takes or a person is in the bathroom. But in and of themselves, that doesn't tell you enough --a worker may be older and a bit slower, or a person may be sick that month. Data which need nterpretation differ from that whose meaning is less open to dispute.

A sixth issue is the ease of application to unrelated areas or potential for abuse. Thus health data can be used to help employees but can also be clearly used against persons. Video surveillance in bathrooms to prevent drug use poses a potential problem not found with card access systems.

With these complex issues in mind, it is possible to suggest a number of general criteria which can be used to evaluate the privacy implications of monitoring technologies.

CRITERIA FOR EVALUATING THE PRIVACY IMPLICATIONS OF TECHNOLOGIES

riteria	Range
Degree of Intrusiveness	high —— low
Frequency	continuous —— rare
Relevance to Job Performance	indirect —— direct.
Visibility	low —— high
Focus	general —— specific
Targeting	categorical ——individualized
Nature of Data Collected	substantive ——transactional
Accuracy	low —— high

Many monitoring technologies can be applied in a number of ways, e.g. drug testing can be general or specific, video can be hidden or visible with a red light when is on. Other monitoring echnologies are more easily coded, e.g. you know when you are hooked up to the polygraph. Given the variety of instruments, uses and contexts, it is not possible to code the technologies in any specific sense. However in a given job setting the following table could be filled in. This would permit more systematic comparisons between different monitoring devices.

CRITERIA FOR EVALUATING MONITORING AND PRIVACY

monitoring device	Video	Phone	Computer	Drugs	Polygraph +
Criteria					
Intrusiveness					
Frequency					
Relevance to Performance					
Visibility					
Focus					
Targeting					
Nature of Data					
Accuracy					

While the diversity of monitoring situations and applications prevents sweeping generalizations, on the average privacy is best protected when monitoring is minimally intrusive (e.g. a video camera in a public area such as a parking lot vs. one in a bathroom stall), is done infrequently (a drug screen as part of an annual physical exam vs. daily body searches), is directly relevant to job performance (monitoring of the phone behavior of reservation clerks vs. that of employees for whom phone usage is a minor part of the job), is visible (a supervisor walking by, a video camera with a flashing red light indicating it is on, a monitored phone in which a beeper periodically sounds to remind people they are being monitored vs. a hidden camera and audio recorder), is focused (requirements for probable cause or randomized monitoring vs. use whenever monitoring is thought necessary), is targeted when there are some grounds for suspicion (perhaps dummy computer files which can trigger an investigation when someone enters them as against randomly looking into employees computer files) and where transactional data are collected (e.g. the fact that a telephone call was made at a particular time and place vs. the substance of the call).

Summary

This section has reviewed monitoring technologies and raised some of the complexities involved in evaluating whether privacy is affected by their uses. The dual nature of technology is such that it can be used to penetrate traditional walls protecting an individual's privacy as well as to create new and stronger protective walls. Indications of how technology can be used to protect privacy were discussed and specific aspects of monitoring were provided, including the analysis of a case study of one monitoring investigation of Federal employees. Criteria to evaluate the privacy implications of technologies were discussed in the final part of this section.

IV. UNDERSTANDING MONITORING

The Context of Worker Monitoring

Worker monitoring means different things to different people. What one person may consider as inappropriate monitoring of Government employees's use of telephones may be considered by another as a necessary cost-cutting measure required in a time of budget cutbacks.

Some of the disagreement over the concept stems from the multiple perspectives that can be brought to bear on it. For example, monitoring can be viewed as a:

"1984" PRIVACY ISSUE, which can serve as a symbol of the fears people have about technology, and distrust of Government and other central institutions, [Westin, SNET, G. Marx]

GOVERNMENT EMPLOYEE ISSUE which in the mid-1980's involves taxes and public opinion, cutbacks in Federal expenditures, privatization of Government functions, and "non-productive" Government workers. [Cf. GRACE COMMISSION]

FRAUD AND ABUSE ISSUE which is a touchstone of efforts to fight crime, criticisms of defense contractor overcharging, organized crime problems, and Government spending practices. [PCIE]

WOMEN'S RIGHTS ISSUE which is a reflection of the fact that a large majority of the workers affected by monitoring are women in types of jobs which have traditionally been low paying, low status, and controlled jobs (the "Pink Collar Ghetto"). According to one estimate, up to 50 % of all American workers will use VDT's by 1990. However, VDT's are operated primarily by clerical works. In 1979, between 85 and 90% of the country's 18 million clerical workers were women. [Feldman, 1983, Westin, 1984].

WORK PROCESS AND PRODUCTIVITY ISSUE relates to changes in U.S. work patterns, lowered performance and productivity indicators, economic forces affecting the growth of jobs, and world trade policies (Japan Inc.") [Strassman, 1985, Allen, 1982, Plasket and Wilneff, 1983]

MANAGEMENT RIGHTS ISSUE which draws upon the decline of unionism, court rulings on the appropriateness of management's ability to review and control worker activities, maximizing investments in information technologies, and definitions of ownership of data and information. [Charp, 1983, Collins and Moores, 1983]

DIFFERING PERSPECTIVES ON WORKER MONITORING

```
GOVERNMENT WORKERS                                FRAUD/ABUSE
                 |                                 |
                 |                                 |
                 ***********************************
   PRIVACY ----* W-O-R-K-E-R  M-O-N-I-T-O-R-I-N-G *---- MANAGEMENT
                 ***********************************
                 |                                 |
                 |                                 |
WOMEN'S  RIGHTS                                 WORK PRODUCTIVITY
```

Thus, worker monitoring stands as a multi-faceted phenomena. As a symbol it may bring into play issues that far transcend the specifics of the situation. This makes it difficult to gain consensus on what the public policy problem is (or if there is even one at all).

Decisions in the Monitoring Process

The multi-dimensionality of monitoring becomes more evident when there is an examination of the variety of persons and factors involved in deciding whether and how monitoring will occur. How is the monitoring process constructed, put into operation, and used by managers in an organization? The answer to this question involves issues of social definition and the use of discretion. [H. Becker, Edwin Schur (The Politics of Deviance]

At least five major stages in decision making in the monitoring process can be identified:

1) **Initiation** of the monitoring idea. The limited literature has not focused much attention on who initiates monitoring. In the Federal Government, the Inspectors General, security, and auditing managers appear to play the major role. Persons who introduce new control strategies do so for a variety of reasons involving personal advancement, organizational commitment, and strategic advantage.

2) **Monitoring categories** are created. Decisions on what types of behaviors are approved or disapproved and on what role monitoring will play must be made. Thus phone abuse may be defined as a problem. But then there must be a decision about

what this means --lines have to be drawn ("calls beyond five minutes are to be reviewed as possible abuses.") Disapproved behaviors have to be translated into monitorable behaviors. Monitoring is rationalized because of its perceived contribution to ongoing organizational functions. Persons likely to be involved in this stage would be nontechnical supervisors and other decision makers involved in cost containment.

3) **Data collection** decisions are made. During this stage, determinations are made about the restrictions inherent in computerized data which restrict or somehow force investigatory categories to be collected in certain ways. For example, qualitative issues such as fraud or abuse of the Government becomes investigated by measuring easily collected data (telephone calls) which have discrete measurement points (distance, time, frequency, and access indicators). It is at this stage that technical ADP personnel may be called into the decision process, often to be advised what they will need to program.

4) **Data testing** is determined. Decisions are made during this stage on how data are to be tested, verified, or authenticated to meet certain organizational or scientific standards. Often, these are social science design considerations involving technocratic decisions.

5) **Information activation** results in value-added data. Information becomes activated by moving from the data collectors/investigators to the managers and supervisors. For this activation to occur, decisions must be made regarding which data will be taken as a meaningful indication and how the data

will be used to extend managerial control. These are essentially nontechnical considerations likely to be made by middle management.

As this brief review suggests, monitoring is not simply a decision to use some technology for new purposes. Monitoring decisions are affected by organizational and societal factors. Some of these support monitoring, while others oppose it.

Factors That Encourage or are Supportive of Worker Monitoring

The Workplace

The distinctive elements of the workplace can be supportive of monitoring. In entering into a labor agreement the worker may implicitly or explicitly give up certain rights and agree to monitoring. Some companies have pledges or agreements that workers sign indicating their awareness of company rules, monitoring, and penalties.

The work setting, like the shopping mall or large university, is a quasi-public, or semi-public place, where the privacy protections that exist in one's home do not apply as directly. Within this broad setting, much monitored work occurs in an open setting which can be seen by others --not within a cloistered, protected area, behind closed doors.

The worker enters premises which are controlled by the employer and uses property of the employer. Given our notions of ownership and control, traditional expectations of privacy are not as applicable (e.g. it is the employer's phone or computer that in principle is being used for a production end defined by the owner).

There are of course limits to what an employer can do. Employees give up some, although not all, of their rights once they enter a factory or an office. Yet even where employees in principle have clear privacy rights (whether legal or moral), violations may go unchallenged. Workers may fear losing their jobs. People may be unaware of their rights. Monitoring (even that which is illegitimate) may simply be seen as a management prerogative and something it is best not to question.

This is particularly likely to be the case in time periods of increased economic insecurity. Then, the concerns of unionized and non-unionized worker are more likely to be with getting, and keeping a job, and less with other elements such as conditions in the work environment. There are probably cycles here with the extent of worker monitoring associated with the relative power of labor and management. This in turn relates to the health of the economy. In the relatively tight economic times of the recent decade, it is viewed as expedient not to rock the boat. Management may meet with less resistance in changing patterns of oversight.

A related factor is the decreasing percentage of the labor force which is unionized. Even existing unions in general seem weaker than in the past. This means that there is likely to be less organized resistance within the work place. In 1985 union membership had declined to just 18% of the work force, down from a high for nonagricultural workers of 35.5% in 1945. [NYT 2/8/86] There is also a shift of jobs from manufacturing to the service sector including insurance, banking, and computer programing. Unions have traditionally not been very successful in those areas and they are precisely where new forms of monitoring are most likley to appear.

Management Oversight Requirements

Another supportive factor is the requirement that managers have active oversight on the work process as well as the worker within that process. Management is increasingly held responsible and legally liable for work situations. In recent years management has even become more concerned over its liability for the behavior of employees. This may extend to off-duty actions as well (e.g. an intoxicated employee who has an accident on the way home from work). Juries seem increasingly willing to find employers liable. Legal responsibilities for fiduciary conduct, product safety, and workplace security have been joined by public relations responsibilities for worker conduct, and profitability responsibilities from stockholders and market analysts.

Management has taken on new requirements at the same time that computerization allows for greater measurement. Computerization allows standardization, flexibility, and control and these three can be applied to work materials, to the processing of these materials, and to the people who are involved in the work process.

The management literature has started to ask how to deploy computer-assisted production devices that promise higher productivity and how to meet possible worker resistance in the course of deployment. [Mirsepassi and Siegenthaler, 1985] In fact, this is not an entirely new quest for management. Brecher 1978, Palmer 1975, and Stark 1980 have shown in great detail how earlier efforts at scientific managment of workers and work processes by Taylor and others were met with fierce resistance by craft and semiskilled workers alike. [Herman, 1982: 13]

A number of international and national developments have exerted pressure on management to increase monitoring. Declining productivity and increased concern over foreign competition are of obvious importance. There is a vastly increased potential for very costly abuses or errors as a result of ever more complex interdependent large systems (e.g. those used for electronic funds transfers, electronic power distribution, and by the FAA, IRS, and Social Security). Concern over increased drug use, the appearance of new diseases such as AIDS and escalating health costs also exert pressure to screen and monitor.

Overall, management functions in a complex setting which not only allows certain forms of monitoring but encourages its use as a means of greater management control.

Technological Capabilities and Economies of Scale in Uses of Monitoring Devices

Technical capabilities and economies of scale in the use of newly developed monitoring devices encourage new applications. Because the monitoring devices tend to be capital-intensive rather than labor-intensive and often involve self-monitoring, it becomes economical to collect much more information. In the past the economics of monitoring tended to work against intensive mass surveillance. The traditional protection for privacy which came from the sheer inexpediency of mass observation applies less strongly today.

Changes in security products have been quite rapid and dramatic. From integrated access control/monitoring systems to mobile robot guards, the security professional has new and improved versions of today's security tools. Improved, wireless sensors are increasingly upgrading the effectiveness of detection devices. Signal transmission, faster and less prone to error, will increasingly put into action a whole range of computer-initiated responses. [Thompson, 1986] In one projection, the overall market growth of information security products is expected to go from $774 million in 1985 to $2.1 billion by 1993, a 171 percent leap. [ibid] In five years, today's biometric product may not even be recognizable. Remote devices, which are able to read characteristics from a distance, will have developed. Such developments are expected to lead to a predicted tenfold increase by 1990 in the biometrics field. [ibid]

The driving forces in changes in security are security systems which are cheaper to maintain than the cost of theft. The convenience and popularity of security system automation, the use of remote, wireless, and increasingly sophisticated technologies are indications of this change. Intrusion detection that once required complete hardwiring will be replaced with wireless technology, especially as new radio frequency sensors become more reliable. Similarly, fiber optics, capable of carrying more signals on tiny plastic fiber, will replace the cumbersome co-axial cable needed to transmit CCTV (closed circuit tv). The move toward microwave, radio-frequency alarm transmission systems make possible multiple functions controlled by a single processor. [Lydon, 1986]

Preventive Emphasis of Management

Prevention is increasingly considered to be one of the major functions of law enforcement. In a similar way, management is increasingly evaluated in terms of its ability to anticipate problems.

This prevention emphasis is not always as attractive as it may initially appear. It can only be measured in the negative, i.e., when something happens, it was not prevented. If something does not happen, it could be due to preventive measures or many other factors. It is also possible to spend resources "preventing" things which were unlikely to happen to begin with.

Managers who understand that they will be held responsible for problems, particularly employee and production problems, are likely to find monitoring attractive. It symbolically suggests they are aggressive in seeking to prevent and identify problems. If problems are found, this very act may be praiseworthy. It may prevent things from getting even worse. Not to monitor when the technology makes it so easy to do so, may make the manager vulnerable to criticism.

Public Opinion

Since the first Harris poll questions in 1970 about threats to personal privacy, the percentage of Americans who report that they feel threatend increased from one in three to three out of four in 1983. [Westin, 1984]

Yet, worker monitoring per se is not a salient issue for most people. There tends to be a lack of consciousness of rights and a failure to define new practices as relevant to privacy. Relative to the importance of the issue, there has been little public opinion research. This is revealing in itself.

Many people are unaware of the potential of the technologies, or of how they are and can be used. While some labor unions and interest groups have raised the issue of worker monitoring, in very few cases has that been translated into union contracts. One indication of union activity on the issue is the work of the Communications Workers of America, AFL-CIO which was instrumental in gaining a law in West Virginia. This was the nation's first monitoring law restricting service monitoring by telephone companies. Several other states have considered similar legislation.

The ideas about the work place and management oversight considered above have their counterparts in popular beliefs which can justify monitoring. Many managers and a sizeable proportion of the public appears to believe that:

a. "if you have done nothing wrong you have nothing to hide"
b. "monitoring is valid because it is based on neutral scientific measurement"
c. "its for the employee's own good" [whether showing proof of innocence, offering just rewards, or to protect health and safety]
d. "its voluntary" [you don't have to work there]
e. "its legal"
f. "employer's have a right to run their business any way they want to"

Of course there are refutations and counter-beliefs as well [e.g. Marx, 1986]. Our point here is not to comment on the accuracy or appropriateness of these beliefs, but to note that their existance within the culture is conducive to monitoring.

Factors That Discourage or Limit Worker Monitoring

There seem to be fewer factors that discourage or limit worker monitoring than those which support it. Nevertheless, it is possible to indicate several major factors.

Technological Uses Which Limit Need for Widespread Monitoring

Monitoring can be limited by legislation and court decisions which set privacy standards and penalties for privacy abuse. It is not apparent at this time that the Congress or state legislative bodies are considering such legislation. Court and arbitration decisions appear to have generally been supportive of monitoring use as an employer right. [A summary of the legal aspects is contained in the report prepared by Westin for this project]

As noted in section III some technical developments such as electronic marking systems on goods may lessen the need to monitor or make for less intrusive monitoring. Attaching electronic markers to store articles or tools has the potential to cut down on shoplifting and employee theft and may lessen the need for searches, although there may be a tendency for electronic marking to be used as a supplement rather than as a replacement for searches.

A social counterpart to the technical means of limiting monitoring is where employees are directly involved in establishing and enforcing norms which limit certain types of behaviors. For example, some firms have programs where, if employee losses are below the previous year, the money saved is split among all of the employees. This serves as a self-enforcing set of incentives for rewarding certain work behaviors and can serve to stem the need for monitoring by management through technology.

Labor-management agreements also have the potential to limit the use of monitoring. Although as noted, other than in a few select cases (e.g. communications workers), this has not been a major factor. Yet managment concern about giving unions an issue to organize around may introduce moderation and caution. In Massachusetts, state-wide organizing around the worker monitoring issue is emerging as an automated office problem.

Workers as well as management may be aware that there are counter-technical devices available to limit the effect of monitoring. These and other protective activities of workers, such as work actions, serve as actual or threatened ways to prevent monitoring. Some of these are considered below.

Related to the union issue is the concern of management over negative impacts of monitoring on productivity. Many managers realize that technology is unlikely to have an immediate payoff in terms of productivity, or even lowering of labor costs, in comparision to hardware and software costs. Moreover, management may realize that a workforce resentful about monitoring, or at least what employees may consider as the more unsettling aspects of monitoring, may well lead to labor actions and subtle or not so subtle efforts at sabotage.

The resources necessary for monitoring can also serve to limit monitoring activities. Some technological devices are so expensive that management may decide not to purchase them, or, if purchased, not to apply them too broadly or routinely. Another type of expense relates to personnel required to produce and to evaluate the montoring data. Limited monitoring resources can even lead to symbolic prevention efforts. As such, the monitoring in actuality may be very limited, although there may be an effort to deceive people into thinking it is much more widespread than it is. As such its goal is really to serve as a scare-a-crow or to increase the risk that violators face by introducing uncertainty about just when and where and how monitoring is being done. Here the monitoring seeks to serve as symbolic deterrence.

Apart from self-interest in not disrupting the workplace, or making it difficult to recruit desirable workers, there are general norms in the culture which certain managers share. Value considerations involving privacy, fairness, deceny, and dignity may serve to limit what is done. Some techniques, even if legal, are just seen to go too far and to be too invasive. As one employer we interviewed put it, "our workers are not our prisoners."

The factors considered in this section serve to set brakes on extensive monitoring. To a degree they serve to balance the factors encourage monitoring noted in the previous section, although the former factors appear more powerful at this time and in the predictable future.

Social Impacts of Monitoring

The literature on worker monitoring is scarce and the type of evidence which would support scientific findings is even less available. Nevertheless, there exists enough information from the literature on computing in organizations and related phenomena that a number of comments can be supported.

Worker Attitudes, Productivity, and Resistances to Monitoring

The research literature on the impact of new information technologies on job content and job satisfaction is jumbled, with two positions most clearly presented. [Attewell and Rule, 1984] The first is deskilling, which suggests that automation is used to strip relatively skilled jobs of their conceptual content, to be built into computerized processes or transferred to a small number of high-level specialists. [Braverman, Shaiken, Taylor]

A contrasting position is that computerization and other new information technologies upgrade, rather than deskill white collar-workers. Upgrading is in this instance taking the drudge work out of the manual aspects of information processing. It is possible that both deskilling and upgrading are occuring, sometimes in the same occupations as automation affects information-processing jobs. [Attewell 5, Kling 59, and Kraemer and Danziger 62. The last two studies are of Government employees]

Workers have come to question how real the promises of technology are turning out to be. In a number of settings, increased or new efforts at monitoring may engender efforts to limit its usefulness. People are not passive objects. They may well fight back, attempting to neutralize monitoring. For example, typists who hold one key down to increase the number of key strokes recorded; police who learn how to beat an automatic vehicle locator system [driving at a high speed beyond the area monitored and then making a quick u-turn], workers in an automated factory who discovered how to deceive the electronic sensors sending data back to a monitor; or persons required to provide a urine sample who add a chemical which distorts the test or turn in someone else's urine. This can also create a black market for means of neutralization.

Monitoring might even unintentionally increase the extent of violations or abuses it is intended to stop -- either because some people see it as a challenge to beat the system, or because of increased anger and estrangement felt by workers. If people feel they are not trusted, this may lead to an attitude expressed by some police regarding corruption that if "you've got the name, play the game", i.e. as long as everyone thinks that you will take graft, you might as well do it. Each device has its own vulnerabilities, although the marginal cost of defeating a system vary greatly.

A related point is that monitoring may create a more adversarial relation in the workplace. Workers may feel invaded, violated, and powerless in the face of new monitoring technology. This may engender lower employee morale, lower performance, and destructive counter measures (apart from the invention of means to distort or block the monitoring as with the neutralization described above). Some observers view the American industrial system is already closely monitored and see this as a factor in making it less competitive.

Work may become less satisfying as people feel they are less in control of it. To the extent that electronic supervisors displace human ones, the potential for growth and learning on the job may be diminished. Less contact with a supervisor may mean a more impersonal work environment. When forms of monitoring such as informing via hotlines are used, there may be lessened interaction with fellow workers and a decline in trust in the workplace more generally.

New monitoring may upset customary understandings between labor and management. It may cut into things that workers have traditionally seen as "perks" and taken for granted as part of informal understandings with management about where the line is appropriately drawn (e.g. the use of the phone or keeping personal letters in an office computer on one's desk business may have the equivalent in the traditional taking home of paper and pencils). A purely technical and legal approach to the use of monitoring will miss the implications for redefining what has previously been assumed to be "tolerated" behavior. There may be ncreased conflict as a result.

As with routinization of any form of control, once it is established, there is likely to be a tilt toward catching the less competent, while ironically making it easier for the very skilled to get away it. [Marx and Reichman, 1984)

The tendency for surveillance to expand was noted briefly in section II. The first scenario in the next section gives a nightmare version of this. Once a precedent is established and the power imbalance between monitored and monitors is increased, the surveillance seems more likely to expand than to retract. It may lead to other perhaps more intrusive forms. There are a variety of reasons for this. To take one example, the search for drugs in the workplace may not stop with undercover agents but may lead to searches, the use of dogs, "electronic sniffers", hotlines, tips for reporting on fellow employees, and drug screens.

Since people may not be sure when they will be monitored, either because the fact that they are monitored is hidden from them, or the actual times when it is done are hidden, deception can become company policy. The effort to trick people into thinking they are being watched, or to create uncertainty, may have a variety of consequences for workers, including increased stress and estrangement from an employer who communicates distrust.

As we noted in section II, the initial appearance of low cost may be deceptive, if the information collected is to be used to actually take administrative action against an employee. There are hidden or secondary costs in validating, interpreting and applying results.

The gross data that categorical monitoring creates must be interpreted. [Wilsnak, 1980] Some additional process of winowing down the data is needed and often additional, more expensive, tests or inquiries are required. This is the case for the results of computer matching and the most commonly used inexpensive drug screens. It is also our impression that only a small fraction of call detail recording data for telephones is analyzed. One manager in pointing to the foot high printout he received monthly on phone behavior indicated that he was overwhelmed by all the information and only used it selectivley, if he had some other grounds for suspicion. Beyond the issue of interpretation, there are the costs of hearings and counter law suits that administrative action may entail. While traditional supervisors may be eliminated, new specialists in the interpretation and application of the results may have to be hired.

It shouldn't be assumed that the mere collection of new forms of information can be automatically applied. Risk assessment, insurance models, artificial intelligence, expert systems, and probabilistic reasoning may mean new problems. What is rational in the abstract and aggregate may not be for particular cases. There can be conflicts between our individual based notions of fairness, rights, and due process and the bluntness of technological monitoring. Red flags and sampling procedures which may make sense on a group level, may fail, or be unfair and violate due process, at the level of the individual case.

As we noted in section II, problems with implementation and unanticipated consequences appear between a technical solution that in principle is possible and the real world application of that solution.

Finally let us conclude this section by briefly noting that monitoring developments may reduce the role and number of middle managers. In considering how middle management decisions are becoming dependent upon computer-based processing Wynne [1983] identifies six possible threats to managerial effectiveness:

* loss of management autonomy if systems are introduced that force managers to comply with a simplistic, 'rational' view of what is required to run an organization

* organizational inflexibility if the systems assume that objectives can always be defined clearly, evaluated unambiguously, and that measurable information is all that is ever needed for decision-making

* deskilling, less job satisfaction and greater stress if the systems reduce the priority and freedom given to the processes of informal persuasion, bargaining, and team building

* avoidance of risk taking and innovation if the systems overly formalize and impersonalize information flows

* emphasizing information quantity, rather than quality and selectivity, could overload the manager and create deleterious effects

* increased organizational conflict because the manager must deal with an extra dimension of complexity.

Broader Societial Impact

In the introduction of this report, we noted that this report was organized along lines of a funnel as we moved from general questions to specific issues of monitoring. Yet it might also be seen to follow the model of an hour-glass. The focused issue of worker monitoring is likely to have broader implications for the society.

Work settings are interesting and important because, given the quest for greater efficiency and the resources large employers have, they may be the first to apply techniques that will later spread to other sectors of society. Work settings are also important because so much time is spent there and because work is central to a person's sense of self. Attitudes and habits learned at work spill over into other areas. Practices first developed and applied at work may become more general. In this sense, what happens in the restricted work setting may have much more general significance. Observing technical innovations in monitoring at the workplace may give us a glimpse into the future of monitoring in society more generally.

One example is the new forms of identification. To the extent that they become familiar at work, they are likely to spread to the broader society and make it easy for the appearance of a national id system. Laws may be passed requiring people (or certain categories) to carry identity cards. This could offer a pretext for searches and also would make it much easier to match records that are now dispersed and listed under different identifiers.

Another example is monitoring and trust. While as we have noted there are benign justifications, monitoring in some forms (categorical, random) also may carry an implication of distrust. It can help create a climate of suspiciousness. When people are searched and watched absent any specific reason to expect violations, distrust becomes institutionalized and an important and even sacred element of the social bond is damaged. The power and horror of novels by Franz Kafka stem partly from the paranoia that comes from uncertainty over surveillance. Absent wrong doing, people may come to feel less free. Even where monitoring is minimal, given its low visibility, there may be a perceived loss of liberty. The concern over the chilling affects on the expression of First Amendment rights is of concern here. It is important to see that liberty involves both actual behavior and beliefs about surveillance. The diminution of the subjective sense of freedom and the spread of mistrust and suspiciousness may be major casualities of changes that begin in the workplace.

The more precise prior screening that will be possible may help create a class of permanently unemployed or underemployed people. The inefficiency of traditional records systems (e.g. lack of information sharing between states, industries, and temporal limitations) meant that persons were often given a second chance. We honor the tradition of moving West and the frontier town precisely because these offered the opportunity to start over again. Moving to a new state and the passage of time supported liberty. Persons who paid a debt to society via imprisonment were to have their rights restored. But with the new data bases and new entrepreneurs selling records on individuals, this is severely constricted. The past becomes haunting. There may be nowhere to run or hide and no second or third chance. It also has a "future" component that is likely to be seen as very unfair. Thus new predictive methods (e.g. genetic screening) will lead to decisions on individuals (e.g. not to hire someone) not because of their past, but because of statistical expectations about their future. This issue can already be seen with respect to persons found to have the AIDS virus, but who have not developed the disease. The work force may be increasingly divided between the good risks with clean backgrounds and others. This negative labeling may have many undesirable consequences. It can create a market for bribery and fake identification. It may mean a waste of human resources as people are kept out of jobs they are otherwise qualified for. Locked out of desireable positions, some proportion of such persons may turn to illegal activities. The demands on the welfare system may also expand.

More omni-present and powerful monitoring may mean increased timidity, fearfulness, and hesitancy to take risks both on and off the job. It may chill political and social expression, as the earlier mentioned phone monitoring that went on in the midst of a union organizing drive or detailed prior histories demanded of employees imply. Security and control may be enhanced but at a cost of a less creative and dynamic society.

Another change has to do with the meaning of the self. As our identity and behavior become subject to more precise, objective, external measurements a redefinition may be occurring in the nature of the self. Person's may increasingly feel that they are only that which is their external definition as a person-- a particular number, retinal pattern, voice print, typing touch pattern, or in a bureaucratic category. Identity increasingly consists of discrete quantifiable and accessable information that is potentially available in computerized form. [Brodeur] Rather than thinking about themselves in family, ethnic or religious terms, people come to define themselves in terms of the various records about themselves in data banks ("a 500 student on the SATS"). This can be mean increased divisiveness and a sense of apartness from others.

Unless limited and used in a more egalitarian way than current trends suggest, the forms of monitoring considered here can mean a decline in the power and autonomy of the individual relative to the large organization. [Rule et al, Burnham] The technology makes visible and permanent information that in the past was not subject to management's purview. The ability to process new information is relatively one-sided, although this need not be the case to the extent we now see it. Here we see a trend that was visible to the French visitor to the United States, Alex De Tocqueville, more than 150 years ago. It now applies to the private sector as well as to the state:

> Everywhere the state acquires more and more direct control over the humblest members of the community and a more exclusive power of governing each of them in the smallest concerns. This gradual weakening of the individual in relation to society at large may be traced to a thousand things.

It is said that if you put a frog into boiling water it will jump out immediately. But if you put it into cold water and slowly turn up the temperature, what happens? It is possible that our expectations are slowly changing, like the temperature of the water. As Sinclair Lewis observed in his novel *It Can't Happen Here*, if American democracy is to be destroyed, it is unlikely to be by sudden catastrophic events. Rather it will be by slow incrememtal changes defined in benign terms. Justice Brandeis put it best:

> Experience should teach us to be most our guard when ...purposes are beneficent. Men born to freedom are naturally alert to repel invasion of their liberty by evil-minded rulers. The greatest dangers to liberty lurk in insidious encroachment by men of zeal, well-meaning, but without understanding.

[Olmstead vs. U.S., 277 U.S. [Supreme Court] 438 (19270]

Summary

Worker monitoring means different things to different people. While not a new phenomena, its current forms are not well understood. There are a number of conditions which contribute to the uses of monitoring, such as changes in the workplace, management oversight requirements, technological capabilities and economies of scale, changes in the nature of work and the work force, preventive aspects of management, and public opinion. There are other factors which discourage or limit the use of monitoring of workers. These relate to laws, alternative technologies, labor-management decisions, and limits to available monitoring resources. It is evident that monitoring can have major impacts on workers as well as the larger social order, although these impacts have not been sufficiently well examined to date.

V. TWO WORKPLACE SCENARIOS FOR THE YEAR 2005

What will worker monitoring be like in the year 2005? Let us identify two hypothetical scenarios. The first describes a heirarchical work organization with maximum feasible monitoring. It combines features of an intensive care unit and a profit-making maximum security prison. The second scenario describes a more democractic organization whose goals are a satisfying work environment and productivity. Imagining the future in this fashion may offer a perspective on the social conflicts that lie ahead. It can also help us to think about what kind of future we would like to see.

The Maximum Security Workplace: Unrestrained Monitoring Scenario

What if there were no limitations on monitoring? What if whatever it was technically possible to do was in fact done? Here we ignore the factors discussed above that currently limit monitoring. We assume that for a variety of reasons (the absence of labor unions, high unemployment, intense international competition, increased concern over crime, drug abuse and medical and liability expenses, citizen indifference to, and lack of knwowledge about privacy and civil liberties, and supportive court decisions and legislation,) the view of monitoring as solely a management prerogative is clearly established.

Maximum feasible control via technology in pursuit of profits and efficiency is the operative standard. The focus is on goals. Managers are able to use surveillance technology in any way they wish. The only limits are economic.

We assume that the developments noted earlier have ccelerated and that monitoring has become ever more inexpensive, intensive, and extensive. It surfaces data that previously were undiscoverable or too expensive to gather. Monitoring is able to probe more broadly and deeply than ever before. At work, and even increasingly away from it, the traditional boundaries between what was public and private have broken down (whether involving physical, physiological, temporal, microscopic, or social barriers).

Privacy has become an archaic concept. The percentage of the population able to give an adequate definition of the concept declines as age does, to a point where most of those under 25 can not define the term at all. Some employees near retirement age grumble about "living in a fish bowl" or "being like a patient in an intensive care ward" but they are seen as quaint relics from the past, liking to tilt at windmills and unable to adapt to progress.

Workers have no information rights. The development of such rights during the 1970s came to be seen as a something that was very inefficient and costly --it protected illegality and decreased productivity and accountability. Economic survival and a well orchestrated political campaign led to the repeal of privacy legislation and labor-management negotiations only involve questions of income.

Monitoring has in some ways reverted back to the company town, where very little was beyond the provence of the employer. Extensive information is gathered about a person's past record and behavior off the job, since these are believed to have important implications for job performance.

Physical movement, words, deeds, and even thoughts and feelings are available to be monitored. Workers participate directly in their own monitoring and computerized data are continuously and automatically gathered and analyzed. Workers know exactly what is expected of them and how they are doing. This permits rewarding outstanding performance. It does however make some workers unpopular with their workmates because they are so much more productive.

Middle level managers have been eliminated. Many workers welcome this, feeling that the machine record is infallible and is neither sexist, racist nor corrupt. Monitoring technology shows no favoritism. What is more, it is equitable. Thus even executives are caught by the video cameras, and they must use the same identity card as others that charts their movement through the office. There are however persistent rumors that the video cameras in executive suites are only for show and have no film in them.

The video screen and audio recorder are always present, though not necessarily always in use. However since it is better to assume they are, workers are circumspect in their interactions. Confidences are not exhanged on the job. Workers are suspicious of each other and tend to keep to themselves. They have good reason to be suspicous, since as part of anti-union campaigns and concern over misbehavior both on and off the job, infiltrators are common. There is also a hotline program in which workers are encouraged to report violations or questionable behavior. Rewards are offered for this.

Using artificial intelligence and expert systems, computer analyses makes recommendations for rewarding and punishing employees and identifies those who appear headed for trouble or should not be hired. An early warning system results in workers being let go who show signs of developing a costly illness, or who appear likely to become less productive. These decisions are based on probability models made possible by analyzing some of the vast amount of data now available on workers.

A new conception of rights has appeared based on membership in a group, rather than individual behavior. The conception favors the large organization and represents a further effort to apply scientific data and rational analysis to the workplace. Drawn from insurance or actuarial concepts, the idea is that individuals fall into certain broad categories about which predictions can be made. It is fair to treat people according to expectations of an aggregate nature. Persons in high risk pools (whether based on the presence of genetic markers, a criminal record, a parent with an alcohol, drug problem, or schizophrenia, or current behavior such as smoking or being overweight) are unlikely to be hired to begin with. In the courts there was an initial struggle between judging persons as individuals and focusing on their actual behavior, as against focusing on aggregate predictions about their likely behavior as members of a group. But this has been resolved in favor of the latter.

The workplace is free of drugs and there is very little theft by employees. Because of extensive pre-employment and continually health screening, employees are very healthy. Yet absenteeism and job turnover remain high. Work slow downs and mistakes are not uncommon. They are however subtle and difficult to label as such. Some observers interpret these as a reaction to the stress of constant monitoring and to resentment over the feeling of not being trusted or valued by management. Productivity and innovation have not increased significantly and some observers even feel they have declined. The work place is however more orderly and standardized.

While it was not intended, a permanent underclass has been created. Individuals cannot escape from their past. Crime and social welfare costs have gone up significantly as a result of the elaborate screening and monitoring of employees and would-be employees. A large group of permanently unemployed people has been created. In some cases this is because of a criminal record, in others because of being fired from a prior job and in still others because of questions about a person's current or future health.

The Democratic Workplace: Structured Monitoring Scenario

The logical opposite of the above is a worksetting with a prohibitionist ethos. The emphasis is on means. The new technologies are simply not permitted because they are seen to invade worker's privacy, create an inhospitable and inhumane work environment and establish precedents that can lead to our becoming a maximum security society. This is perhaps even more unrealistic than the laissez faire scenario described above. Since monitoring is prohibited there is little more to say.

But instead of the mirror image of the first scenario, let us suggest one that involves a more democratic balance between competing interests. It does not ban monitoring and surveillance, but ensures that when they are done, that this is in a way which is fair, open, and with adequate protections for those who are being monitored. Let us also assume that it occurs in a setting where workers have a significant say over the conditions of work and where a satisfying work experience is an important goal, along with adequate productivity.

There is a Constitutional Amendment protecting privacy. This followed piecemeal legislation which banned or restricted the use of video, computer and telephone monitoring, drug screens, and the polygraph. Violations by management are subject to fines and workers whose privacy is invaded may sue for damages. A permanent Privacy Study Commission issues an annual report. One part of this deals with the state of work monitoring. Many states have created the position of Privacy Ombudsman. The Ombudsman can help people who feel their rights have been abused and can also independently seek out violations.

The surprise unionization of a sizeable percentage of the white collar work force has given organized labor increased power and helps to account for the above. One other important result is union-management teams that jointly seek ways of using (and developing) technology to further agreed upon goals. The technology is not viewed as the prerogative of management, although it provides the funds for the research and development. Decisions on technology in the workplace are discussed as points during negotiations, where considerations of impact on workers, productivity, and cost savings are considered. A quality-circle approach helps avoid some of the problems monitoring seeks to reduce.

There is however a presumption against new forms of monitoring. Management must make the case for it. There is also a presumption toward using monitoring to measure group averages, rather than individuals and toward using it for training purposes rather than punitively. There must be fair notice. The monitoring must meet standards of reliability and must be clearly relevant to job performance. Clear distinctions are drawn between monitoring for purposes of personnel administration, for protecting the property and other financial interests of the employer, and for general law enforcement purposes. The results must be made available to those monitored, confidentiality must be guaranteed, and any action must occur within a limited time period after the monitoring (thus violations can not be saved up over many months). There must be a human intervening between technical monitoring and the application of results. Where possible, the results of the monitoring are independently verified. Where monitoring is deemed appropriate (e.g. telephone salespersons whose calls are listened to and tallied), there must be provision for personal phones which are not monitored (e.g. in an employee's lounge). Grievances can be filed and these can be taken all the way to arbitration.

The extreme forms of monitoring are limited not only because of these political factors, but because such practices are seen to go too far and to be too costly in terms of unintended consequences (although in a some cases it seems to be to avoid giving union organizers a potent issue around which to organize and to create a favorable public image of the company) . Management's philosophy is to treat workers with dignity and trust and to create a congenial work environment. Productivity is highly valued (but quality is generally given greater emphasis than quantity) and this is not taken to the point where workers are seen as just another object in the production process. Some companies feared that in adopting this ethos that efficiency and productivity would seriously decline. To their surprise, the opposite occurred. In addition, there were a number of other positive benefits such as less job stress, improved employee health, lower health insurance costs, fewer accidents on the job, and reduced absenteeism. In response to management's trust and clear statement of its desire to create a work environment that offered job satisfaction and was also productive, workers took on new responsibilities and helped enforce company rules, since these were generally seen to be in their best interests as well. This self-monitoring by workers along with increased productivity appeared first in worker owned companies but quickly spread far beyond this.

Summary

Monitoring patterns can be drawn out by creating scenarios which reveal key ingredients. This section has contained some suggested scenarios of what work monitoring will look like in the year 2005. Based upon different sets of assumptions regarding information ownership, technological uses, and stakeholder power positions, two scenarios of the future were prepared. An unrestrained worker monitoring scenario provides a picture of monitoring decisions being made by management without external legal or internal employee constraints. The second scenario is a scenario where worker monitoring is structured around worker-management negotiations, with monitoring considerations being structured by monitoring impacts on employee work life, productivity, and other features of the work environment.

VI. INFORMATION PRIVACY AND INFORMATION SECURITY RELATIONSHIPS

This section of the report contains a discussion of information security, which is the second major project issue selected for examination by OTA. The discussion will be limited to a highly important but quite specific set of problems regarding the relationships between information security and privacy. A more indepth discussion of information security in the Federal Government is available from OTA [Sanford Sherizen, Federal Computers and Telecommunications: Security and Reliability Considerations and Computer Crime Legislative Options, Contractor report prepared for OTA, February 1985].

There is a common assumption that information security and privacy go hand in hand, supporting each other, and functioning in some sort of peaceful coexistence. The often heard phrase "privacy and security" is misleading in suggesting a commonality of interest and purpose. Information security and privacy are quite different concepts and, in fact, they may not be mutually supportive at all. In some instances, they may minimally coexist while in other instances they may serve potentially conflicting sets of requirements.

While the contradictory nature of the concepts will be presented in this section, consideration will also be given to the ways by which privacy and information security can be made to function in mutually supportive ways. Privacy can become more a part of security considerations, advancing privacy protections along with advances in technology and information security.

Comparisons Between Privacy and Security

> "Privacy and security are related but not synonymous. Privacy addresses the use of data about individuals. Security is about the accidental or intentional theft, modification, or destruction of data. Although breaches of security may, in fact, compromise privacy, they may also be unrelated to privacy. For example, the theft of a mailing list stored on magnetic tape is a result of poor security and may compromise the privacy of individuals on that list. But the destruction of the tape, also a breach of security, does not necessarily have privacy ramifications." [Alexander Gaydasch, Jr., Principles of EDP Management (Reston, VA.: Reston Publishing Co., 1982.]

While privacy and security both suffer from a lack of sufficient attention and concern, there are distinct differences between the two concepts. Generally, information privacy is not as "sexy" an issue as is information security and, according to comments heard from a number of Government officials during this project, not considered as a very important topic in most Government offices. Clearly, much has changed since the Privacy Act era in the mid-1970's.

Privacy protection is a more ambivalent concept, often lacking in specific definitions and open to political battles around ownership of property and information. While there is privacy legislation, it tends to have a lower order of importance in comparison to the more "immediate" needs concerning security. Privacy has less of a logical home, except for legal and/or human resources, which tends to give privacy a particular cast, not necessarily one of power and organizational profit (or its Governmental eqivalent).

On the other hand, information security protection is an objective which is easier for many people to understand and around which to establish programs than is privacy. Security subjects include risks and vulnerabilities, losses and asset protections, and physical analogies to intangible property. Since security is somewhat easy to understand, products to meet security problems are able to be developed. Further, information security has a logical homebase in organizations within which to locate its programs. Security programs can be located within an existing organizational unit, such as the security/MIS/ADP/IRM unction.

More specifically, privacy and information security can be compared in at least the following major ways:

* DISTINCT POWER SOURCES AND VALUE ORIENTATIONS OF ADVOCATES. Privacy and information security tend to attract support from quite distinct types of advocates, who differ in values, by educational backgrounds, and by occupational specialties. Privacy advocates tend to have a civil liberties perspective, often serving as lawyers within an organizational environment. Information security advocates differ not only in their job positions but also come from a different pool of people, particularly those who have law enforcement, national ecurity, intelligence, and data processing or technical perspectives. While this might mean that privacy advocates would

have political power to raise issues, as occured in the 1970's, the implication today is that the advocacy of privacy has become an isolated phenomena (an "ACLU-civil liberties issue") rather than a more encompassing, more generalized, more popular value. In comparison, security has attracted more advocates, particularly since it has become a more global issue, intertwined with larger campaigns for national security, hacker controls, and even viewed as a privacy protection.

* DIFFERING ORGANIZATIONAL CONTEXTS. Each tends to function within specialized organizational contexts which have differing assumptions and technical infrastructures. Privacy operates within a legal and human resource setting in many organizations, where privacy is defined by legal, personnel, and essentially nontechnical environmental considerations. In contrast, information security tends to function in security, data processing, communications, IRM, and/or other specialized areas. Individuals with lesser administrative power operate with technical perspectives which have impacts on human aspects of organizational life. The implications of these differing organization contexts is that both security and privacy tend to get isolated within organizations, creating great organizational difficulties in responding to problems. Security may be somewhat easier to implement than is privacy, since those involved in technological applications may be given a wide scope of responsibilities. However, both privacy and security requirements get "slotted" into narrow sets of requirements, often minimizing efforts to control crimes and abuses.

* GOALS AND OBJECTIVES ORIENTATIONS. Privacy and formation security support distinct and, in some instances, conflicting organizational goals and objectives. Some of this difference is due to the legislative sources directing privacy and security tasks. Privacy efforts are directed toward limiting access to data, information, and files which can have a negative impact upon individuals. Information security, while ostensibly covering privacy protections as well as protection of equipment, resources, and other organizational assets, tends to have less specific standards and is often more prone to "interference" by production demands. In essence, both privacy and security may be seen as creating difficulties for organizational processes and procedures, i.e., as anti-productive orientations. Many managers view the problem as production **versus** protection or privacy, ich limits the chances for successful programs.

* DEGREE OF EMPHASIS ON TECHNICAL VERSUS PROCEDURAL CONTROLS. Privacy and information security have quite different types of emphases. Privacy tends to be more procedurally or managerial control- oriented, with technical supports for those administrative decisions. Information security tends to emphasize technical controls, although procedural controls are recognized as an important aspect of security while often given lesser emphasis. The implications of these differences is that privacy may be able to involve nontechnical managers **if they consider it an important area** whereas information security, **even if it is considered as important,** may not as readily involve nonchnical managers.

* INFORMATION OWNERSHIP DIFFERENCES. Security tends to be one-sided, emphasizing the protection of organizational information and organizational rights to that information. Privacy, on the other hand, is more oriented toward protecting information of individuals, both from each other as well as from organizations. The privacy emphasis is that individuals own information about themselves or, at a minimum, have rights to protect themselves from misuse, inaccuracy, obsolecence, or other inappropriate forms. Massive computerization has rapidly shifted information ownership patterns, with organizations holding an increasing amount of information about individuals, while individuals have lost their abilities to be the major repositories holding information about themselves. [Chaum] These differences in who is considered as owning what information accounts for at least some of the greater management interest in requiring security controls than ensuring privacy protection controls.

COMPARISONS BETWEEN PRIVACY AND SECURITY

DIFFERENCES IN:	**IMPLICATIONS FOR:**
ADVOCATES	POWER TO INFLUENCE
ORGANIZATIONAL CONTEXTS	ABILITY TO IMPLEMENT
GOALS AND OBJECTIVES	PROGRAM SUCCESS
TYPES OF CONTROLS	MANAGERIAL INVOLVEMENTS
INFORMATION OWNERSHIP	MANAGERIAL REQUIREMENTS

Privacy and information security are not contradictory, per . Rather the factors listed above affect how organizations treat each of these approaches. Information security has developed at a more rapid rate and possibly has achieved a more sophisticated level than has privacy. As technology evolves and information security develops in the future, there could be secure systems which lack adequate privacy protections. The near future may hold more information security but less information privacy than now exists.

In order to have privacy protections and information security function in non-contradictory fashion, there is a need for integrative mechanisms to make them operate together. After a discussion of the various types of relationships between privacy and information security, the last part of this section .ll provide specific instances of how to achieve this merging of privacy and security efforts.

Legislative and Non-Legislative Sources for Privacy and Security

While the societal concerns of today differ from the early 1970's environment which affected the passage of the Privacy Act, what has also changed is the ability of technology to collect, manage, manipulate, and add value to information about individuals and to distribute this information for profit, surveillance, and other purposes. Control over the technology rests, in large part, upon legal constraints.

There are a variety of governmental issues which are related to privacy and security. During the 1970's and into the 1980's a number of laws were passed. Major legislation which embody many of the principles of privacy rights the are:

- Fair Credit Report Act of 1970
- Crime Control Act of 1973
- Family Educational Rights and Privacy Act of 1974
- Privacy Act of 1974
- Tax Reform Act of 1976
- Right to Financial Privacy Act of 1978
- Protection of Pupil Rights of 1978
- Privacy Protection Act of 1980
- Electronic Funds Transfer Act of 1980
- Debt Collection Act of 1982
- Congressional Reports Elimination Act of 1983
- Cable Communications Policy Act of 1984

Confidentiality provisions are contained in several statutes, including the Census Act, the Social Security Act, and the Child Abuse Information Act. Statutes requiring disclosure include exemptions to Internal Revenue Code 6103, the Debt Collection Act, and the Deficit Reduction Act. [Loudon] Individual agencies have also established privacy protection regulations and requirements.

Information security also has a legislative base. Four "ndirect" legislative acts which stand out in their impact on protecting information without directly being security laws are the:

- Brooks Act
- Paperwork Reduction Act of 1980
- Crime Control Act of 1973
- Privacy Act of 1974

Other Federal activities which affected the development of information security programs are the Foreign Corrupt Practices Act and Executive Order 12301, which established the President's Council on Integrity and Efficiency (PCIE).

There are a number of major policies and reports which more directly addressed information security, [Sherizen] including:

- OMB Circular A-71, Transmittal Memorandum No. 1
- OMB Circular A-123
- OMB Circular No. A-130
- The Task Force on Computer Security (Ware Report)
- PD-24
- National Communications Security Directive (June 1979)
- Small Business Computer Security and Education Act of 1984
- NSDD-145

In addition, agencies have established their own sets of policies and procedures. Several examples of these are found in the recently released OTA study, **Federal Government Information Technology: Management, Security, and Congressional Oversight**, pgs. 80-81. [OTA]

The Counterfeit Access Device and Computer Fraud and Abuse Act of 1985 addresses aspects of information security through its jurisdiction over Federal information systems as well as its history of legislative intent. H.R. 2889, the **Computer Security Research and Training Act of 1985**, currently under legislative review, if it is passed in its present form, also could have a major impact on how information security becomes structured in the Government.

Information Security As Necessary But Not Sufficient for Privacy Protection

Security is one of the prerequisites for implementing privacy protection. Data, computer, and telecommunications security need to be instituted in order to prevent unauthorized access to equipment or data, to prevent any deliberate denial of service to authorized users, and to protect the system from physical damage.

It is possible, according to certain experts [Committee on Multilevel Data Management Security, Air Force Studies Board, Commission on Engineering and Technical Systems, National Research Council, *Multilevel Data Management Security*, Washington, DC: National Academy Press, 1983] that major advances in computer and telecommunications security may be on the horizon. Certainly, the implementation of NSDD-145 or any similar centralization, expansion, and funding of information security efforts could well lead to major technical improvements in security. From a privacy perspective, however, it is not clear whether more secure systems and data protections will necessarily, inevitably, or even likely improve privacy protections. A case could be made that systems will become more secure in the future while the privacy of data will not improve or even become less protected. With the current attention to information security, it is necessary to raise privacy protections as a linked-but-separate issue which requires specific attention.

Security can positively affect privacy. Various data and file protection devices and other means of limiting access to authorized users have the potential to provide privacy protections if that is an objective of the security operation. Current security development work at the NSA could have an even more major impact on privacy. As an illustration, consider the work of the Development Center for Embedded Communications Security Products, a project involving a team of security experts from NSA and 11 leading computer and communications companies including A.T.&T., GTE, IBM, RCA, Motorola, and Xerox. It began operating about a year ago, with the purpose of developing relatively inexpensive and easy-to-use devices that will encode and decode the messages generated on personal computers, cellular telephones, and other communication systems. [David Burnham, "U.S. Agency Makes Vast Plan to Encode More Information", *N.Y. Times*, December 29, 1985] While the major impetus for this development work is protection against foreign enemies, these products might also be used by individuals and organizations to protect the privacy of their own information.

Yet, ironically, security also may become one of the major obstacles to privacy protection. Security as an impediment or inadequate protection for privacy can occur at least in the following ways:

* Insufficient security methods are available to protect information.

* Ineffective security measures are applied which allows for privacy invasion or misuse of data.

* Inappropriate access rules are established by management, creating opportunities for authorized users to gain access to files and information which they should not or need not be privy to, thus affecting privacy.

* Security systems may be structured to "lock out" those who wish to review their own records while minimally securing systems from privacy misuse by sophisticated hackers, "super user" level personnel, and certain other authorized personnel.

* Security may be based only upon certain levels of protection and/or concentrate on certain limited aspects of systems while leaving other privacy-related vulnerable points unprotected.

* Security emphases may be assumed by management to protect privacy consideration, resulting in resources for privacy not being allocated on this basis.

- Those in charge of instituting security may not have a privacy perspective, minimizing or overlooking technical functions which collect and reformulate discrete information bits into potentially invasive data on individuals.
- New applications or devices allow privacy invasion for which no security consideration have yet been developed or considered.

These various ways by which security may not provide privacy protection or serve to hinder privacy protection underscore the separate nature of the two concepts. There does not appear to be a necessary natural relationship between privacy and security.

Another indication of the difficulties in automatically achieving privacy protections through typical information curity programs can be seen by the vast differences between products and devices available for security and for privacy. While security protection products tend to cover a number of clear categories, privacy protection products are less easily defined or located. Security protection products and devices include physical, procedural, hardware, software, and firmware controls. Some of these are dual purpose, providing protection for security as well as privacy objectives. There are much fewer privacy protection products. These mainly focus on encryption, auditing packages, data base management systems, and assorted other data integrity and access control products.

Assumptions based upon what some consider as a necessary relationship between privacy and security may flounder for lack of ways to establish a fit. It is necessary to actively support ways to integrate security and privacy within system planning and operations. It is not a question of **either** security or privacy. Rather, the question is how best to make them **both** achievable.

Weaknesses in the Privacy Act

The Privacy Protection Study Commission pointed out several shortcomings of the Privacy Act. Ambiguities in language needed to be clarified. Reasonableness tests should have been included to allow flexibility. The definition of system of records should have been replaced to apply not only to records that are retrieved by a unique identifier but also by algorithm or attribute search. Different categories of records should have been defined so that different rules could be applied to the different categories. Finally, the Act should have been extended to include the identification of routine internal use, not just external use, particularly since most individual's concerns are with the internal use of data. [David K. Hsiao, Douglas S. Kerr, and Stuart E. Madnick, Computer Security, New York: Academic Press, 1979]

Since that time, more general weaknesses in the Privacy Act have been raised. These involve the operation of the Act's supporting mechanisms as well as organizational uses of technology:

-It fails to provide for an independent enforcement chanism, a Privacy Protection Commission. Instead, the Office of Management and Budget was given responsibility for enforcing the Act and developing guidelines. In both of these missions, OMB has failed to act. Most importantly, OMB has permitted agencies to freely share information in large-scale matching programs.

-It vests enforcement of the Act with individuals who may recover actual damages by bringing civil suits if a Government agency willfully and intentionally violates the Act. To date, no significant suits have been brought. Many scholars contend that individuals may not know their privacy rights have been violated (how does the individual know that the Internal Revenue Service is misusing his or her records?), the damages may t be quantifiable as in property damage, and the Act provides no recourse to individuals whose records have been abused by virtue of incompetence, error, and mistake.

- It fails to provide concrete guidelines or general performance criteria for the development of new systems and the enhancement of existing systems. The only restriction on Federal information collection is that no information concerning the exercise of first amendment rights is permissible and that only information 'relevant and necessary' to accomplish a purpose required by statute may be collected.

- It fails to prevent because of ambiguous language the development of general purpose, national information systems pable of widespread social surveillance. The OMB in both the Carter and Reagan administrations sabotaged the 'routine use' clause by claiming routine use is any use the agencies say is routine. Currently a broad 'Government interest' doctrine governs the exchange of information among Government agencies, evident in a statement from the Office of Personnel Management on the transfer of personnel records: "An integral reason that these records are maintained is to protect the legitimate interests of the Government and, therefore, such disclosure is compatible with the purposes for maintaining these records." [Loudon, p. 4]

Technical Security Requirements in Implementing the Privacy Act

The Privacy Act and related privacy legislation have technical implications. The legislation requires certain basic technical implementation standards to prevent the misuse or compromise of data containing personal information. These include notification, inspection and review, accounting requirements, data quality, and data security. [Fernandez, etc., p. 20] Beyond the specifics of the Privacy Act requirements, there are other requirements required to meet privacy and data integrity. These include good system design, proper data collection and storage procedures, effective supervision over data handling, establishment of policies and practices, and identification of information requiring special protection. In the material to follow, the requirements will be presented and the corresponding safeguards used to implement the provisions will be discussed.

The code of fair information practice [Secretary's Advisory ommittee on Automated Personal Data Systems, U. S. Department of HEW, RECORDS, COMPUTERS AND THE RIGHTS OF CITIZENS, 1973] contained five basic principles for the protection of privacy in relation to automated personal data systems. The Privacy Act of 1974 expanded these five principles into the following eight:

(1) **The Openness Principle.** The existence of no personal data record-keeping system shall remain secret, and there shall be a policy of openness about an organization's personal data record-keeping policies, practices, and systems

(2) **The Individual Access Principle.** An individual about whom information is maintained by a record-keeping organization in individually indentifiable form shall have a right to see and opy that information

(3) **The Individual Participation Principle.** An individual about whom information is maintained by a record-keeping organization shall have a right to correct or amend the sustance of that information

(4) **The Collection Limitation Principle.** There shall be limits on the types of information an organization may collect about an individual as well as certain requirements with respect to the manner in which it collects that information

(5) **The Use Limitation Principle.** There shall be limits on the internal uses of information about an individual within a record-keeping organization

(6) **The Disclosure Limitation Principle.** There shall be limits on the external disclosures of information about an individual a record-keeping organization may make

(7) **The Information Management Principle.** A record-keeping organization shall bear an affirmative responsibility for establishing reasonable and proper information management policies and practices that assure that its collection, maintenance, use, and dissemination of information about an individual is necessary and lawful and that the information itself is current and accurate

(8) **The Accountability Principle.** A record-keeping organization shall be accountable for its personal data record-keeping policies, practices, and systems. [U.S. Privacy Protection Study Commission, Personal Privacy in an Information Society 497-536 (1977)]

Three major safeguard categories can contribute to the implementation of these principles.

Physical security can assist in the protection of personal data against unauthorized destruction, disclosure, or modification. Examples of physical security are entry controls to data centers, restrictions over access to remote terminals, and protection plans for data storage media.

Information management practices refer to the operations performed on information, including the handling of personal data, the maintenance of records to trace the disposition of personal data, controls over data processing and programming practices, assignment of individual responsibilities over operations, and procedural auditing examinations.

System-based security for the protection of data includes identification of each individual who is allowed to use a system, access controls over who is authorized what activities over personal data and files, access auditing which accounts for who has access to what data, and network system controls. [National Bureau of Standards, *Specifications for Computer Security Guidelines for Implementing the Privacy Act of 1974*, Federal Information Processing Standards Publication 41, Washington, DC: GPO, 1975]

These security guidelines for implementing the Privacy Act of 1974 can be summarized in the following manner:

PRIVACY REQUIREMENTS AND EXAMPLES OF CORRESPONDING SAFEGUARDS

REQUIREMENT	SAFEGUARD
Control of Disclosures	Entry Controls
Accounting of Disclosures	Storage Protection
Access to Records	Data Handling
Disputed Information Inclusion	Record Maintenance
Use of Relevant Data for Authorized Purposes	Data Processing Practices
Accurate, Complete Records	Responsibility Assignment
Ensurance of Integrity, Security, and Confidentiality	Auditing & Encryption
Record Retention	Identification

While reports from GAO and other agencies have pointed out that many of these basic safeguards discussed are lacking in the majority of Government agencies [OTA], technological changes since the Act's passage have made the privacy protection problem even more complex.

These changes in technology have privacy implications. As one indication of the growth of computers and telecommunications in our society since the Privacy Act was passed, it is estimated by the NSA that all the modems purchased in 1972 could together transmit about 600,000 characters per second. In 1984, sufficient modems were purchased in the U.S. to transmit 220 million characters per second. [Burnham, NY Times] Consider the privacy implications of having to identify and authenticate incoming and outgoing transmissions for tax, credit card, or similar personal information.

Other technogical requirements which have emerged since the Privacy Act similarly create serious protection problems. Information management functions now encompasses information processing, database processing, and network processing. These have grown to encompass new forms of manipulating information to produce desired results, storage of information in forms appropriate for processing and the control of access to the information, and the control of information movement between the user community and the information processing and database resources.

POST-PRIVACY ACT TECHNOLOGICAL ASPECTS & INCREASED PRIVACY NEEDS

TECHNOLOGICAL ASPECT	PRIVACY NEEDS
REAL TIME ACCESS	DATA INTEGRITY CONTROLS
MICROCOMPUTER-BASED OFFICES	AUDITING USER ACTIVITY
INCREASED MEMORY AND STORAGE	DATA BASE CONTROLS
MICRO-TO-MAINFRAME LINKS	INFORMATION CONTROL

The regulation of data to meet privacy as well as security standards has become an increasingly complex problem. It is difficult to determine how best to regulate the acquisition, maintenance, dissemination, and access of information in today's environment. Specific information on the technical difficulties relating to privacy protection will be presented in the next section in order to provide some direction for updating privacy legislation.

Technical Complications in Updating Privacy Legislation

The recasting of privacy-related legislative standards into technical mechanisms is complicated by:

(a) the nature of technologies which may create new opportunities or unexpected conditions for privacy invasions

(b) technical complications or difficulties in instituting security or other protections which will have an impact on the nature, types, and level of privacy protections

(c) difficulties in the structuring of ongoing institutional or other mechanisms for privacy protections

Viewed in another way, there are several reasons why assuring total compliance with privacy protection requirements in a computerized record-keeping system may not be technologically feasible. As discussed by a subcommittee of the IEEE Computer Society in their review of the Privacy Act,

1. It cannot be proven that the system is secure.
2. Auditing of the system software and operation cannot be done with high confidence due to the complexity of tracing the system transactions and difficulty in understanding the software. Proving software correctness is infeasible for all but very small systems.
3. It is not possible to prove that the systems software or applications programs have not been designed to circumvent privacy protection requirements or to mislead authors. Clever techniques can be used to hide deception. "Shadow systems" can be designed where auditors may find full compliance while the real programs and data are maintained in other systems.
4. Even if continuous monitoring to detect compliance violations can be set up in a record-keeping system, information can still be leaked out because of the lack of solutions to the confinement problem.

"In general, it is not possible at the present time to verify positively without the cooperation of the organization being audited that its automated record-keeping systems are in full compliance with privacy protection requirements. That is, it is not possible to prove that the organization maintains no secret record-keeping systems, that it permits individuals concerned to access and inspect all personal data it maintains about them, that it is not engaged in clandestine information exchanges with other organizations, and that it is not using personal data in its systems for decision-making purposes that have not been publicly announced. While technical solutions to the auditing problem are being developed, they are likely to be complex and costly. For example, it may be necessary to design and install tamperproof accounting systems to be operated by enforcement agencies that are similar to flight recorders now used in aviation. In the interim, **it may be necessary to depend on the expectation that ethical employees will inform privacy protection oversight agencies or the media of privacy protection violations.** [IEEE Computer Society, Technical Committee on Security and Privacy, Subcommittee on Privacy, *Technological Implications of Privacy Protection*, July 1979, pgs 14-15. (Emphasis added)]

While there have been major changes in security and auditing since these comments were made during what could now be considered as a much less complex information processing era, changes in information processing technology and the user population are such that this statement continues as a critique of current privacy problems in Government.

Privacy Implications of Biometric Identification & Authentication Devices

In order to indicate the way that security considerations can have a major impact on privacy, recent technical advances in identification and authentication will be examined. A series of developments have occurred in the identification and authentication of users. A long existing problem in information security, complicated by remote access capabilities of present systems, is the identification of the person and the device as authorized and appropriate. Passwords and special cards, while continuing to have an important role in security, are not sufficient for certain environments. Hackers have quite clearly shown many of the ways to bypass these.

Identification and authentication are essential for privacy as well as security. Without sufficient means of determining who is authorized to access what data, privacy may be threatened. Unauthorized access to credit card information, health data, and criminal histories-all of which have occurred in the last several years--is an indication of the need for controls.

Among the types of biometric products which are under development or are available in the marketplace, the following general categories indicate movements beyond the simple passwords concept.

Wrist Veins
Fingerprints
Signature Dynamics
Voice Identification
Keystroke Dynamics
Typing Rhythms
Hand Geometry
Retinal Patterns
Thumb Print

These range from products in the prototype stage to actual production and availability on the market. [PIN (Personal Identification News), *1986 Biometrics Scoreboard*, January 1986] PIN estimates that over $35 million was spent in 1985 by companies preparing biometric and quasi-biometric products.

These products can improve the ability of Federal agencies and the private sector to limit access to systems and to privacy protected data. Yet, as earlier discussed, there is a potentially large tradeoff involved in **how** security controls are used. If these products are used only for security reasons, without privacy being considered as of similar importance, a decrease in privacy protection may result.

While many of the biometric devices have been developed for information security purposes, there are many other ways that they could be used. An argument might be made that the protection of personal data and other sensitive information residing in systems require sophisticated access controls and identification. Yet, there might be situations where the use of biometric measures might be considered as overly invasive of privacy of employees, particularly if used as a substitute for existing managerial controls and supervision. Examples of this were discussed in a January 1986 OTA workshop, where many of the products were demonstrated. A leading hotel, which tried to cut down on workers punching in each other's timecards, decided to require all employees to undergo a biometric form of checking their own cards in and out of work. At least one university is using biometrics as a means of checking students who go through food lines to see if they have paid their monthly food charges. Restaurants have started to inquire whether they can avoid hiring unregistered aliens by requiring biometric identification.

These uses, as well as others which are anticipated, suggest that biometrics may affect the continuity of basic privacy protections. It may be appropriate for the Congress to consider the impact of biometric approaches prior to these products becoming established within organizations. Several major issues which might be considered are:

Structuring Use Limits. The Collection Limitation Principle of the Privacy Act could be applied as a guide to structuring limits on the use of types of information an organization may collect as well as the manner in which it collects that information. Similarly, the Use Limitation Principle of the Privacy Act could be used to establish guides for limiting biometric devices only for the protection of computer systems and data.

Ensuring Voluntary Participation. Another difficult problem raised by the biometric products is how to ensure voluntary participation by employees. How can informed consent be established in the collection of biometric information? Some of the products can even be used without the person under review being aware of the monitoring. The Privacy Act's Collection Limitation Principle and Use Limitation Principle might again be of assistance in structuring appropriate guidelines.

Disclosure Limitations. There are issues related to the growth of biometric databases. Large databases could be established within a company or agency, containing merged biometric and work performance information about individuals. This information could be value added, by selling, trading, or otherwise distributing it. Questions arise as to whom owns personal biometric data about an individual, that individual and/or the organization which used its equipment to gather the data? It is possible that biometric information could be exchanged between organizations as a form of private sector dossier database. It is unclear at this time what guarantees might be required over the privacy of the data. The Privacy Act's Disclosure Limitation Principle and the Information Management Limitation Principle could provide standards for such a database development.

These points are to indicate the complexity involved in the protection of privacy. Since these products have just started to make a dent in the marketplace, Congressional guidance on how to achieve security and privacy is needed now. Unless this is forthcoming, the uses of these products will become institutionalized as crime fighting tools only and become much more difficult to regulate as privacy protection tools.

Coordinating and Integrating Privacy and Security Efforts

The discussion to this point is based upon two major assumptions, i.e., (a) technological developments may decrease the level of privacy sought under the Privacy Act of 1974 and (b) information security developments may not provide adequate or appropriate privacy protection. If these assumptions are correct, there is a need to consider the technical, organizational, and legislative means of improving the privacy situation.

This section will contain a discussion of some of the ways by which privacy and security efforts can be coordinated and integrated.

Structuring a Commmonality of Purpose

Privacy is often affected by some of the less visible forms of technology. That accounts for at least some of the reason why privacy is so ill understood and under appreciated. The public itself, only glimpsing an occasional example of these technological invasions, is not pressuring legislators or agency officials to do something about privacy. Recent public privacy discussions have been based upon quite limited issues and have failed to inform or ignite the public into requesting better privacy protections. Radio show hosts talk about the invasion of privacy of mandatory seatbelt laws, while, at the same time neglecting the unabated collection and dissemination of personal information continues. Privacy continues to worry people but the worry has yet to crystalize into a political set of standards.

There is a lack of public clamour or agency rewards for official attention to privacy. One Government official with whom this project was discussed summed up (or possibly overstated) what appears to be a wide-spread feeling. "Nobody in Government takes privacy seriously nowadays. They don't even think about it." Others interviewed had difficulty relating to the concept of privacy, unclear as to what it meant, what they needed to do about it, or how their agency treated it. Relatively few in Government and even fewer outside of Government were even aware of the implications of NSDD-145 and NSDD-196 (polygraph testing) on privacy.

The public privacy discussion is not a debate, although there are several clear political stances which could be taken. As discussed today, privacy is viewed in narrow legal grounds and often lacks a sense that there are possible solutions to the onslaught of technology. While there are no easy answers, certain directions for those answers have become more evident.

David Chaum's work has raised several important issues. It is built around a recognition of how information processing and security decisions of Government and businesses have changed the nature of the balance between individual rights of privacy and organizational decision making. The approach is summarized below from his widely discussed and praised paper. [David Chaum, "Security Without Identification: Transaction Systems to Make Big Brother Obsolete", **Communications of the ACM**, 28, 10 (October 1985), 1030-1044] He seeks to rebalance the legitimate privacy needs of individuals with the legitimate needs of organizations to have computerized record-keeping systems. His approach has three major ingredients which differ from the present way that transactions are made.

The first relates to the way by which identifying information is used. Rather than continue to increase the use of universal identifiers, exemplified by the social security number in the U.S., he suggests that an invidual use a different account number or "digital pseudonym" with each organization. This pseudonym, which will be created by a special random process, will serve to identify an individual for billing and similar purposes. Information further identifying the individual will not be used. Although the pseudonyms cannot directly be linked to individuals, organizations will be able to ensure that the pseudonyms are not used improperly, such as for fraudulent purchases.

A second difference is in who provides the mechanisms to conduct transactions. Today, "tokens" such as numbers and plastic cards, are owned by the issuing organization and contain information on that individual. Individuals carry these identification sources and invade their own privacy since they must reveal their own secrets to the organization's processing mechanism (ATM machin or point-of-sale terminals) in order to ake a purchase. Un er the Chaum system, individuals would conduct transactions u ing personal card computers. A purchaser would communicate t the card computer a special secret authorizing number whi h would authorize a transaction.

Thirdly, there are security differences from current approaches. Current s stems emphasize the one-sided security of organizations attempti g to protect themselves from individuals. The proposed approach allows all parties to protect their own interests. Individual keep their secret keys from organizations and organizations de se other secret keys that are kept from individuals. During transactions, parties use these keys to provide each other w th specially coded confirmation of the transaction details, ich can be used later be used as evidence improper actions su ficient to resolve disputes.

This approach i a long way from being implemented or possibly even impleme table. In order for this new approach to work, there would be need to reorganize a number of existing organizational arran ements. Credential clearinghouses might have to be establish to develop credential information about individuals' relation hips with its member organizations and to provide this informat n to those organizations. Other legal and organizational change would also be required.

Yet, this approa is intriguing since it use technology for privacy enhancement y limiting the growing surveillance potential of technolo ies. For individuals, it would create a ind of equal parity th organizations, allowing convenience and reliability which pr tect against abuses by organizations and control over how personal information is used. For organizations, this approach would allow continued computerization, improved security, goodwill from the public, and possible lowering of certain forms of legal liability. Security and privacy would have a commonality of purpose. Developments for a rebalancing of powers could be established. While there is a lot of work which this approach requires, Chaum's work may start an important dialogue based on the realities of technological contributions to privacy invasions as well as privacy protections.

Merging Privacy Protections Within Security Operations

Many of the information security products now in the marketplace or those under active research and development can provide privacy protections **depending upon managerial control decisions.** Neither security nor privacy can be assured through technical means alone. Access decisions, resource allocations, information classification requirements, effective supervision over data handling, and other nontechnical managerial decisions are essential factors for the successful implementation of techncial security controls. It is quite easy to emphasize the technical aspects of the various hardware and software devices now on the market. Yet, the technical solutions to information security and privacy rely upon nontechnical decisions. When privacy and security programs fail, the failure is often due to limited nontechnical input, which restricted how effectively protection programs can operate. [Sanford Sherizen, "The Role of

Management in computer Security", DATAPRO Reports on Information curity, Delran, NJ: DATAPRO Research Corporation, February 1986] Among management's nontechnical decisions which have a major impact on the functioning of privacy and security efforts are:

* Determining Privacy, Data Ownership, and Security Requirements
* Integrating Agency Objectives and Privacy/Security Objectives
* Making Program Decisions to Achieve a Balance Between Production and Protection Needs
* Establishing Appropriate Resources Needed and Available for Privacy and Security Programs
* Making Policy Determinations on Appropriate Rewards, Protection, and Punishments for Privacy and Security Violations

In lieu of legislative changes in the Privacy Act, privacy can most directly be improved if Administration and agency management become more directly involved in linking privacy with the security requirements now being formulated.

This particular moment offers an important opportunity for privacy to become redefined and merged within security operations. There is a momentum to increase security within the Federal Government. NSDD-145 in particular is a highly significant change in the way that the Government is responding to information security and in the classification of information.

The major objectives found in the Directive are:

1. a reliable and continuing capability to assess threats and vulnerabilities and to implement appropriate, effective countermeasures.

2. a superior technical base within the Government to achieve this security, and to support a superior technical base within the private sector in areas which complement and enhance Government capabilities.

3. a more effective application of Government resources and encouragement of private sector security initiatives.

4. support and enhancement of other policy objectives for national telecommunications and automated information systems.

As can be seen, these major objectives of the Directive leave room for privacy to be considered. What is needed is a high level judgement that privacy is important for that effort.

An indication of the limited ways privacy is seen as fitting into central policies for information security is found in a recent hearing on computer security policies and NSDD-145. The interchange is between Congressman Dan Glickman of Kansas, member of the Subcommittee on Transportation, Aviation and Materials of the Committee on Science and Technology and Mr. Donald C. Latham, Assistant Secretary of Defense for Command, Control, Communications and Intelligence (C3I) and, at that time, Chairman, National Telecommunications and Information Systems Security Committee (NTISSC), U. S. Department of Defense.

> **Mr. Glickman.** OK, in your charter, I hope that you will, if you don't now, have some focus for privacy considerations. That is, you know, DOD is obviously concerned, as it should be, and NSA, with security concerns affecting the national security of the United States.

Mr. Latham. It doesn't explictly go into details on privacy. I am not sure where we should put that. We possibly could include it as an additional area, but I would say that that has been discussed in the committee, and everybody is keenly aware of the issue of privacy and protection of the individual's rights, and so on.

And one of the things that we have tried to do is not only to involve the Federal agencies in some of these decisions, but involve the industry, in general, and the public, in general. Specifically, in the discussion of the security of telecommunications satellites, commercial communications satellites, and perhaps other satellite systems, nonmilitary, we went out and solicited views of the public in general, and of the industry specifically as to how they viewed that particular policy document.

And we intend to do that in all of these areas, so that we make sure that we are, in fact, reflecting the will of the people, you could say, and not just a narrow view taken by some bureaucratic committee.

Mr. Glickman. Well, I hope that you will consider, as you review your charter, and the organization, some specific reference to privacy statutes--

Mr. Latham. All right, I will take that as an action item.

Mr. Glickman. Because, you see, even with respect to changing technologies, functions that we just automatically assumed were protected with respect to individuals may not be, as we move into all forms of exotic technologies, and I just think it is important that if you are going to be doing this thing, that you at least appear that you have this as one of your basic focuses.

Mr. Latham. Well, let me give an example: Suppose you find that some-and there was one-entry into one particular hospital's medical records. You would like, I think, to protect your own personal medical records, because the insidious situation is someone can get in and alter your record.

So this form of protection of your privacy is very important, and yet you are going to have to be a bit relaxed at this protection system that someone would impose, let's say, on a medical records system. In fact in your best interest, and in the public's best interest, which I think it is.

Mr. Glickman. That's right. Well, what I would like to tell people, is you, Secretary Latham, should assume that not only are you protecting the Government and the Government's records and Government security, but your own personal record.

Mr. Latham. Yes, sir.

Mr. Glickman. Part of the same process as well.

Mr. Latham. Yes, sir.

Mr. Glickman. OK. We appreciate your testimony. Thank you very much.

Mr. Latham. Thank you. [U.S. House of Representatives, **Computer Security Policies**. Hearing Before the Subcommittee on Transporation, Aviation, and Materials of the Committee on Science and Technology. Ninety-Ninth Congress. First Session. June 27, 1985. 32-33]

This interchange, which is virtually the only mention of privacy in these important hearings, takes up less than 2 of the 179 pages in the hearing transcript. Since that time, Mr. Latham has been removed from his NTISSC chairmanship and there are no indications in the public record that privacy has become part of the charge of that committee.

It appears that regardless of whether NSA will continue as the lead agency for this security effort (as formulated in NSDD-145) or whether there will be some leadership split between national security and civilian agencies (as formulated in H.R. 2889), the momentum for security change is clear. Unless privacy is made as an explicit facet of these changes, any later efforts to improve privacy protections will have to be added onto already existing security changes and may be much more difficult to achieve.

Thus, the potential for privacy to be merged within security erations requires an emphasis upon the nontechnical managerial aspects and a determination on how best to involve privacy as part of the NSDD-145 movement toward security centralization.

Making Privacy Protections Standard Operating Procedures for ADP

Privacy requires appropriate data processing as much as it does security. Privacy and related data integrity require such efforts as good system design, proper data procedures, effective supervision over data handling, establishment of policies and practices, and identification of information requiring special protection. In short, privacy needs to be built into and upon standard operating procedures for ADP.

Yet, this is quite difficult in today's computing and ommunication environment. Beyond the problems of gaining agency interest in security and privacy, other ADP-related difficulties are:

* Differences between various vendors' information processing systems

* Differences between various models of a given vendor's offerings (upward compatibility)

* Differing code sets and control characters used in data communications

* Differing protocols used in data communications traffic management

* Variations in the growing number of languages used for the development of applications and databases. [Hal B. Becker, *Information Integrity*, NY: McGraw-Hill, 1983, 11]

While there has been movement toward reaching some common standards, this may not meet the particular privacy and security needs of the Government. Three distinct but interrelated issues are at the heart of the problem for the Government.

The first problem relates to Government ADP operations. There are a large number of GAO reports which indicate the lack of security safeguards. A year-long study released last year before the House Science and Technology Subcommittee on Transportation, Aviation and Materials showed grave shortfalls in agencies. Management responsibilities which were found absent for all 25 systems studied included risk management, security training, assigned responsibility, budgeting and accounting for security costs, ADP personnel security, contingency plans, independent audit and evaluation, and written procedures. Only 10 of the systems studied were found to have adequate audit trails or logs. If this is the situation with security, how much worse must privacy protections be, particularly given the differing emphases between security and privacy discussed at the start of this section.

The second problem is the existence of different definitions of privacy and security within national security and civilian agencies. The growing prominence of the definitions and concepts coming from the DoD Computer Security Initiative and the DoD National Computer Security Center may not be applicable for civilian agency needs. The DoD notion of improved security seems to constitute (a) better system integrity to assure that users and programs can only access information as authorized and (b) the introduction of the lattice model of non-discretionary erating system mechanism for access authorization. [Steven B. Lippner, "Non-Discretionary Controls for Commercial Applications," *IEEE Proceedings of the 1982 Symposium on Security and Privacy*, and reprinted in the *Proceedings of the Fifth Seminar on the DoD Computer Security Initiative*, National Bureau of Standards: Gaithersburg, MD, May 24-26, 1982, 143-152] Lipner's comment about the difficulties in applying this to the private sector can also be considered for civilian agency applications. "The lattice model, however, is derived from national security policies and regulations, leading to some question as to its suitability in non-national security data processing environments." [p. 143 of *Proceedings of the Fifth Seminar*] NSDD-145 has the potential to turn these definitions nd concepts into mandatory standards. This may not be sufficient for the civilian agencies to meet their particular needs and environments.

The third problem is the way by which the private sector views the Government market and its requirements. The lack of clear Government policy requiring the use of trusted products or other products related to security and/or privacy has contributed to this private sector disinterest. The Government's strategy for increasing the availability of secure products has been based on DoD efforts. This has involved the concept of defining security criteria, specifying standard classes of trust, and evaluating commercial products against these standards. The valuated Products List and publication of certification results also are part of this effort directed at the private sector. The absence of a successful strategy for promoting the availability of such products has led to a limited market for these products. There is little incentive on the part of the vendors to rush into the development of new trusted products until a significant new customer base other than the Government emerges with strong security requirements.

In essence, there are serious difficulties in making privacy protections standard operating procedures for ADP. In order to meet these difficulties, consideration will have to be given to establishing mechanisms to incorporate security and privacy measures within ADP operations. Efforts to establish civilian agency definitions and concepts for privacy safeguards useful to the Government as well as commercial setting will be very helpful in this regard.

Major Technical Issues Required for Current Privacy Protection

Privacy protection today in many ways is a database problem. A database, containing data of various degrees of organizational sensitivity and individual importance, creates a problem of how to control shared access. Data are shared among a variety of users, requiring restrictions over the users to ensure that they can access only those portions of the total data necessary for their activities. Controls are also necessary over what changes a user can make to data, in order to minimize inappropriate hanges and to ensure accure and accountable changes. [National Bureau of Standards, *A Database Management Approach to Privacy Act Compiance*, NBS Special Pub 500-10, June 1977] The underlying systems, such as the operating system and the hardware, must also be secure and reliable.

A number of major problems will be discussed before we move onto future developments in security and privacy. Database shared access and control is a central problem. While security and privacy protections are not unique to database management, there are special protection problems involved.

In order to protect privacy as well as confidentiality of data, two principal problems must be resolved. The first, often called privacy transformations, is to conceal the content in user-database communications. The second, often called access control, is to determine who can perform what operations on what data.

Privacy transformations are techniques for coding data in user-processor communications or in files to conceal information. Privacy transformation consist of sets of logical operations on the individual characters of the data. Among privacy transformations are:

> *Coding*. A word in one language replaces a group of words for another.
>
> *Compression*. Remove redundancies and blanks from transmitted data.
>
> *Substitution*. Letters from one or more items are replaced.

Transposition. All the letters in the clear text appear in the ciphered text, but in a distorted sequence.

Composite Transformation. Combinations of the above.

Encryption.

[Ken Brathwaite, Data Administration, p.58]

Access control regulates access to objects. Its mechanisms control user access to a system or subsystem as well as process access to various objects within the system. The degree of sharing permitted vary from (a) no sharing at all, (b) sharing originals of program or data files, (c) confined, or memoryless subsystems, and (d) controlled dissemination of information. National security systems have a number of other degrees of sharing control models. Enforcement mechanisms are represented by access matrix models which include the set of all objects to which access must be controlled, a set of access domains, which is a set of rules specifying which processes may use wich set of objects, and the access matrix, whose rows correspond to domains and whose columns correspond to objects.

Information flow controls regulate the dissemination of values within the system. The mechanisms permit only authorized flows to occur. One method of specifying a flow policy is based on defining a set of security classes and associating each object with only one class at a time. A flow relation partially orders the security classes. This allows privacy and security goals to be structured.

While the mechanisms discussed to this point can provide certain levels of protection, they are not always sufficient for meeting the complexities of today's systems nor are they always sufficiently used by agencies. A number of major technical problem areas continue to be of importance for privacy protection.

One major problem area is the importance of data quality in large records systems. Certainly, privacy requires data which are correct, timely, and appropriate. Yet, as research has indicated, methodologies for examining records quality have not been established and few systematic research efforts have attempted to acertain empirical levels of data quality. [Kenneth Laudon, "Data Quality and Due Process in Large Interorganizational Record Systems," Communications of the ACM, January 1986, Vol. 29, Number 1. 4-10] Interestingly, the only exception to this is the state and Federal benefit programs where Congress has mandated specific error levels and where agencies have undertaken extensive "quality assurance" programs to analyze record and decision-making qualities. These studies focus on payment errors but may be used to support the idea that data record quality examinations can also be used for privacy protection purposes. As Loudon indicates, " (w)ith the exception of arbitrary standards adopted by legislative bodies for the benefits, there are no really enforceable standards of data quality, accuracy, or completeness in governmental systems." [Laudon, 5]

As one indication of the complexities involved, there are even problems with establishing definitions of the key concepts. Integrity is a basic data processing concept relating to data as well as systems. Database integrity has been defined as the state that exists when the computerized data in the database are the same as that entered into the database management system and have not been exposed to accidental or malicious alteration or destruction. [NBS, FIPS PUB 88, Guideline on Integrity Assurance and Control in Database Administration, 1981] Yet, integrity, which is so basic to security and privacy, has been found to have at least six distinct meanings:

1. How correct (we believe) the information in an object is.
2. How confident we are that the information in the object is actually from the alleged source, and that it has not been altered from the original form.
3. How correct (we believe) the functioning of a process is.
4. How confident we are that the functioning of a process is as it was designed to be.
5. How concerned we are that the information in an object not be altered.
6. How correct we hope the information in an object is.

[Sig Porter and Terry S. Arnold, "On the Integrity Problem," Proceedings of the 8the National DoD/NBS Computer Security Conference, Gaithersburg, MD 30 September-3 October 1985, 15-17]

A related privacy and security problem is the need to tablish consistency of protection mechanisms in current systems. The security and privacy of data in a particular system depend both on the integrity of the computer's protection mechanisms and on the consistent uses of those mechanisms by the users of that computer. Software verification and specification technology are available to address aspects of integrity. Yet, very little has been done to insure that the protection mechanisms are being used consistently. There is a need to establish a means of finding inconsistencies in the set of protection decisions made by the users of an information system.

To increase the usefulness of computers, system designers have provided an increasing number of mechanisms that allow users to execute commands and share information. These mechanisms ould properly be considered as part of the protection system, although they are often overlooked as a security factor. As an example, if users can specify a set of commands that will be executed automatically every night, then the database that contains those commands and the program that processes the database must be considered part of the protection configuration or portion of the access matrix specifying how each user can access each object. In this regard, it is important to have means of ensuring that the protection configuration is consistent with an organization's security and privacy goals.

Work on establishing a means of ensuring this is now taking place. Baldwin appears to be one of the first to have tablished a rule-based security checking approach to the problem. He has generated attacker-oriented rules to determine the types of goals that are relevant to an attacker of the target system. These goal types are deduced from the basic protection model of the operation system. Aspects of the protection system are examined in terms of the goals an attacker could achieve. A goal-table is the basic data abstraction used and rules are expressed as lines of a shell script. Work on this project will expand beyond its present Unix emphasis. [Robert W. Baldwin, Rule-Bases Analysis of Large Protection Systems, Ph.D. Thesis (in preparation), MIT, Laboratory for Computer Science]

A final area to be briefly mentioned in privacy protection is the use of encryption. The potential uses of encryption have grown as the economies of scale have taken place. The variety of encryption products now available is amazing, considering how quickly these products have developed. Yet, there continues to be a relatively minimal use of encryption, particularly in the civilian agencies and the private sector. While there have been claims that encryption today need not have a negative impact on performance, the difficulties involved with key management and other features of encryption use have limited is adoption. It may be that there will be an increase in its use with the expansion of non-DES products and increased embedding within applications. Efforts by the NSA mentioned elsewhere in this paper may allow encryption to be used with minimal effort required by the user, creating a user-friendly encryption system. That may have as great an impact on the spread of its use as its technical capability to security and privacy.

Technical Requirements Possible in the Future

It appears from a close reading of the open literature that there are enormous resources being applied to Government information security. NSDD-145 is more than a simple document. It represents a part of a major concerted effort to protect national security-related information, with that term being broadly defined. A number of the activities now being planned or implemented will have an impact on privacy.

One activity is central to NSDD-145 and that is the leadership role of NSA. The NSA is increasingly presenting itself, in unusually public terms, as a service agency for the Government as well as the private sector. This has raised questions in Congress about the appropriateness of this organization becoming involved with civilian agency information .d security efforts. [Computer Security Policies, Hearings before the Subcommittee on Transportation, Aviation and Materials]

Other activities involving NSA are less controversial, at least at this early stage of their development. An uncertain reception has been given to NSA's quasi-public announcement that it will replace the DES with other codes. [Gina Kolata, "NSA to Provide Secret Codes," Science, 4 October 1985, 45-46] The DES will not be reapproved in 1988. Rather, the NSA will supply keys to all Government agencies that use the new codes and give the code-making algorithsm to qualified U. S. companies with appropriate security clearances.

The Data Network Security Project is another effort. It is a long-term project aimed at improving the protection offered information transmitted around the United States on various commercial data and telephone networks. It will include joint research with industry on techniques to improve security on local networks, like the electronic systems used to link the offices of a company scattered around a single city. The development of a relatively inexpensive and easy-to-use device that will encode and decode the messages generated on personal computers, cellular telephones, and other communications systems was mentioned earlier in this paper. Most publicized of security products being developed are the 500,000 secure telephones announced last year, which will be designed to make eavesdropping of Federal officials almost impossible. [David Burnham, N. Y. Times]

Beyond the public efforts, there are other research and development activities which build upon the strong base of U. S. expertise in operating system security and formal specification and verification technology. A major conclusion of a study by the Air Force Studies Board of the National Research Council [Committee on Multilevel Data Management Security, Air Force Studies Board, Commission on Engineering and Technical Systems, National Research Council, Multilevel Data Management Security, Washington, DC: National Academy Press, 1983] is that computer security technology has advanced to the point where certifiable multilevel database management systems can be built for several specific applications in a three to five-year period. The following were considered as the areas where there is the greatest research and development need.

In the near future, operational applications of high-payoff cure DBMS architectures were recommended, based on identified security and database management technology. Secure DBMS architectures showing promise of yielding necessary security trust and system performance are integrity locks or cryptographically sealed records, kernelized or secure operation systems, and distributed DBMS or stand-along back-end DBMS. Improvements in meeting the needs of multilevel secure document handling were also recommended.

The long-term recommendations were to develop a mathematical model and language for expressing classification policies, research to develop a database security model whereby data are classified and protected at the view level, extending work on inference controls for statistical databases, development of pert systems to assist in the formulation of security policies, the classification and control of views, the analysis of audit data, and research on how cryptography can be applied to database systems protecting at the view level.

These research and development efforts, if funded and proven feasible, will significantly tighten the security of systems. In particular, these developments could offer greater control over data creation and storage by means of architecture as well as the use of advanced expert systems for review and analysis purposes. The impact on privacy will depend upon how actively privacy needs are considered in these efforts and the policy considerations made on the highest levels of the Government.

Summary

This section of the report was written in order to provide OTA with a review of the relationships between security and privacy. From an examination of the problems involved in attaining both privacy and security, a discussion was presented on how current information security changes in the Federal Government may have a negative impact on privacy protections. A number of factors have been suggested which could contribute to increased privacy protection. The future, while filled with great activity in information security, may hold less privacy assistance unless concerted efforts are made to increase the importance of privacy to the Government as well as the private sector.

VII. POLICY ASPECTS

The future of monitoring and its impact on privacy is unclear. From our present understanding of monitoring, it has been possible to develop the general scenarios for the year 2005 presented earlier. Yet, twenty years from now we are unlikely to end up with either of these scenarios. The great diversity among work settings precludes this, as does a welter of conflicting social forces. Laws, customs, competing interest groups, and the social factors discussed earlier are likely to mean some new balance between contending interests. In many areas there will likely remain a gap between the potential of monitoring and its actual application. Well publicized abuses from a new monitoring technology may operate to create new laws and policies that limit it, even as newer technologies and competitive pressures operate to extend it in other ways.

Technology is inherently neither good nor bad. Its evaluation depends on how it is used and for what ends. The technologies that are developed and the way that they are applied are likely to reflect and to reinforce existing patterns of social stratification. Observers with different values and in different social positions will disagree on what types of monitoring or within what contexts are appropriate.

Policy considerations must be informed by questions of both means and ends. The following table suggests four situations:

		MONITORING MEANS	
		ACCEPTABLE	UNACCEPTABLE
MONITORING ENDS	ACCEPTABLE	#1	#2
	UNACCEPTABLE	#3	#4

Of course, different observers will select different combinations of means and ends. Some of the means and ends considered in the first scenario discussed earlier clearly fall into cell #4. Cells #2 and #3 call our attention to the need to think about means and ends independently. A legitimate goal does not justify an illegitimate means. And the fact that data may be collected via a legitimate means does not therefore mean that it is necessarily acceptable, apart from an appropriate goal. For example, in principle an interview is an acceptable means of gathering information but if the questions asked are irrelevant to the performance of a job, such as the political beliefs of an applicant for a job in a fast food chain, it is not acceptable. Policies should be specific to particular situations and be certain to consider both means and ends separately and in their interrelation. The fallacy that the end justifies the means must be avoided, just as assuredly as the fallacy that the means are their own justification.

The technology under discussion can serve important social ends. Yet it is hardly an unmitigated good. As this report has hopefully made clear, other consequences beyond the seeming contribution to efficiency and enhanced control must be considered. As with many new developments, there is the implicit assumption that if something can be done, that it should be done. Yet the means should not determine the end. It is important to avoid faulty assumptions regarding technical fixes. The sense of certainty seemingly offer by a machine can be illusive. Beyond issues of validity and reliability, there is a danger of abdicating moral responsibility by falling back on machines to make judgements which should be made by humans aware of the richness of contexts, nuances, and mitigating factors. Humans can be held accountable and machines can quite appropriately supplement but not replace human judgement. [S. Cook] The move from a technical solution to implementation is often very difficult and complex. There are no cost free solutions and trade-offs and paradoxes abound. Sometimes the cure will be worse than the disease. One cannot always have things both ways and sometimes it may be better to live with a problem than to try and solve it. Innovations that work in the short run may not work in the long run or the problems may be displaced to spread to areas where they are undesireable.

As our discussion suggests, the new and emerging technologies for collecting and processing information have mixed consequences. How can these be shaped and limited such that we maximize the positive aspects and minimize the negative? Monitoring is not about to be suddenly abolished, nor should it be. While it is difficult to go from general principles and rights to any given specific application, the kinds of criteria/factors that ought to be considered in reaching judgments can be suggested.

WORKER MONITORING POLICY ISSUES

As indicated in a number of places in this report, worker monitoring is an ill defined and complex issue. The lack of empirical research on the topic, inadequacies in current legal privacy protections limiting our ability to identify how privacy is affected by monitoring, and the rapid growth of technological means of monitoring all contribute to quite difficult policy problems. Nevertheless, certain policy-related areas appropriate for Congress' consideration have become clear from our analysis.

1. PROTECTIONS AGAINST IMPROPER MONITORING

It is evident that certain types of technological monitoring have been and will continue to be used in the workplace in lieu of Congressional and other societal developments. While it is not possible to determine the exact impact of monitoring on workers, it is possible to indicate certain factors which would be considered as improper or inappropriate by some contemporary measure of privacy, legality, and/or community standards of appropriateness. The policy choices for the Congress hinge on a selection of what types of monitoring are to be considered as appropriate and which have crossed some line(s) into inappropriate activities. The Congress can assist in creating appropriate monitoring by establishing certain groundrules, particularly to include the means of structuring monitoring activities to require:

* Reasonable Grounds. Require specified reasonable grounds and and formally proscribed reasons for undertaking monitoring as a means of limiting monitoring to a need-to-use basis. While reasons can always be found for programs, criteria can be established as baseline measures reflecting the necessity rather than the convenience of monitoring activities. This might restrict monitoring from becoming a normal operating procedure which could result from the ease of technological use.

* Relevance. Apply the same protections that apply to pre-employment background checks, such as now exists in Maryland requiring that only information relevant to the job be collected, to apply to job monitoring. The burden of proof for the need to monitor should lie with the manager or employer to make a case for the relevance of the monitoring. This is an issue of how to make monitoring minimally intrusive relative to the importance of the end and the availability of alternative means. Related to this is the data age issue, where the older the data, the less their potential relevance to current activities and the greater the disadvantage an employee has in challenging or correcting its use for evaluation purposes. This suggests a "statute of limitations" on data from monitoring use.

* Proper Procedures. There is a need for the appropriate methods and techniques of monitoring to be established. Rather than have the technology or management determine monitoring decisions in a policy void, due process and other standards for appropriate monitoring can be developed. These can include advance notice provisions to employees as well

as active mechanisms for undertaking their rights of inspection and appeal. Proper procedures might also require human review of monitoring results to interpret and verify machine- produced information prior to these results being used for evaluation or punishment of employees.

* Monitoring Alternatives. Monitoring can be made to be understood as one choice amongst a number of options rather than as the first and only choice for crime control and cost containment. One way to establish this purposeful choosing is to require impact statements prior to monitoring being allowed. The costs of monitoring, including the resources necessary (to design, establish, carry out, analyze, and prepare reports) as well as potential privacy impacts (on employees' privacy and potential for misuse of data collected) should be spelled out and compared to alternatives. At a minimum, the technical preventions and controls should be compared to monitoring as alternative control mechanisms to restrict possible fraud and abuse.

* Redress. Adequate mechanisms for redress are necessary for all employees, but especially for those whose rights are violated or who otherwise are subjected to mistreatment by a monitoring system. These redress rights would include the rights of inspection and appeal mentioned above as well as the potential for employees to collect sufficient damages as partial payment to them when unwarranted or inappropriate

monitoring occurs. This could provide a deterrence message to employers who undertake such monitoring, particularly if damages are sufficiently high, such as found with the treble damages of certain consumer law cases.

2. ESTABLISHING STANDARDS FOR MONITORING

In addition to the points made above which could contribute to standards for monitoring, there are several other policy considerations which could be suggested.

* _Monitoring Reports_. It is evident from this report that there is a need to ascertain the extent of monitoring in the Federal Government. One way to establish a monitoring database is for agencies to be required to provide to OTA or another ppropriate agency an annual monitoring activities report as a means of identifying how prevalent and in what form monitoring is occurring. This would be a retrospective view of monitoring. A less reactive posture could be accomplished by another type of report requirement. A privacy implications statement could be required prior to monitoring efforts. This statement would have to be reviewed and accepted by upper management or a privacy review agency.

* _Legal Standards_. There is a need for monitoring standards, particularly for establishing adequate levels of validity, reliability, and currency. The false positive issue, often raised with polygraphs [OTA] and other technical measures to ascertain evidence of wrongdoing or untrustworthiness, can

also be applied to evidence gathered by monitoring. Not only should there be operational standards (validity, reliability, and currency) but also of standards setting the acceptablity of monitoring-developed information serving as legal evidence. In the case of legal evidence, the "Frye standard" offers a model. [Giannelli, "The Administration of Novel Scientific Evidence Frye v. U.S. A Half Century Later" _Columbia Law Journal_, vol. 80, 1198-1250]

* _Federal Employees_. Standards for monitoring are required not only to determine whether and how monitoring should be carried out but also if there are distinct classes of citizens who can be monitored. While justifications can be made for monitoring and other means of employee surveillance over certain national security-related employees, it is not clear that Federal employees _as a class_ have less monitoring protection rights than employees in the private sector. The Congress may have to establish some basic monitoring standards for Federal employees, indicating whether these employees should be treated differently than other citizens. Another form that the Congressional interest can take in this regard is to determine whether certain rights and protections which Federal employees have, such as civil service and "whistle blower" protections, can be applied to private sector employees in regard to protections from certain forms of monitoring.

3. RESEARCH ON MONITORING

A large number of questions continue to be unanswered concerning monitoring, now and in the future. Basic and applied research is needed on certain key issues in order for the society to take advantage of the positive aspects of monitoring while minimizing its negative aspects.

- Monitoring and Stress. It is important to determine whether monitoring leads to employee stress. Such findings could help to determine whether there are certain productivity costs of monitoring. If this was the case, cost-benefit judgements not possible today could be made.

- Deterrence. Research on deterrence is available from the field of criminology but has not been applied in any sophisticated fashion to controlling employee theft or abuse. Research on how deterrence could expand the number of available management tools useful to protect the public interest. Deterrence could be used either as a supplement to or as an alternative to monitoring.

- Monitoring Conditions. A survey of Government agencies and selected private sector organizations could provide a census of monitoring activities and policies regarding its use. It is important to determine under what conditions monitoring tends to be used, who establishes monitoring standards and policies, and employee reactions to being monitored. This research could serve as a database for establishing the relationships between privacy and monitoring and provide policy makers with a greater awareness of the extent of monitoring as a social phenomena.

PRIVACY POLICY ISSUES

As indicated earlier in this report, there are a number of legislative acts which provide for the privacy rights of citizens. Yet, it is clear that many of these protections have been outmoded by technological changes, private sector database linkages, and Governmental interpretations which allow for the use of universal identifiers and extensive computer matching. Worker monitoring has an impact on privacy, although, as indicated, the impact is a mixture of positive and negative aspects. What is needed is for the Congress to address several privacy-related issues which will affect worker monitoring practices as well as other social issues undergoing change. While several of the policy issues discussed earlier under worker monitoring apply to privacy, other policy issues can be suggested.

1. REVIEW OF PRIVACY PROTECTIONS

In this year of the Constitution, it is appropriate for the Congress to review the state of the nation's privacy. Rather than responding after- the- fact to various technological developments or mass media stories on privacy problems, the Congress could:

* Reexamine the Privacy Act. There are provisions of the Privacy Act which have been found to be outmoded or inadequate given technological and organizational changes. (For further information, see Section VI of this report.) Some of the weaknesses found in the Privacy Act which the Congress could examine and consider correcting are the following.

(a) Different categories of records should have been defined so that different rules could be applied to the different categories.

(b) The Privacy Act fails to provide for an independent enforcement mechanism, but gives the Office of Management and Budget responsibility for enforcing the Act and developing guidelines. To many, OMB has failed to emphasize privacy.

(c) The Act vests enforcement of the Act with individuals, who may only recover actual damages by bringing civil suits if a Government agency willfully and intentionally violates the Act. To date, no significant suits have been brought. Individuals may not know their privacy rights have been violated, the damages may not be quantifiable as in property damage, and the Act provides no recourse to individuals whose records have been abused by virtue of incompetence, error, and mistake.

(d) Existing legislation fails to provide concrete guidelines or general performance criteria for the development of new systems and the enhancement of existing systems.

(e) Because of ambiguous language, the 'routine use' clause has been used to undercut the Act by the Government claiming that routine use is any use that Federal agencies say is routine.

(f) damages may not be sufficient to prevent future acts of agencies or by individuals.

2. ESTABLISH MECHANISMS FOR PRIVACY PROTECTIONS

Even if a particular act, such as worker monitoring, is found to violate one's privacy, there are few mechanisms presently available to ascertain, investigate, protect, or otherwise serve as a forceful advocate of privacy rights. Congress could respond to privacy protections without revising the Privacy Act by:

* Select Committee on Information Technology, Privacy, and Security. Such a committee or subcommittee could coordinate the various oversight responsibilities now found among a number of Congressional Committees. It would increase the visibility of privacy as a Congressional concern and provide active review of privacy protections.

* Privacy Ombudsman. As in the case of Canada and several European countries, a special official could be assigned major privacy protection responsibilities as well as powers to carry out that assignment. This official could serve as a centralized source for complaints regarding privacy problems as well as an early warning system for alerting the Congress to patterns of privacy problems created by technological changes.

* *Commu cations Act*. There are current legislative fforts to update ıe privacy aspects of communications systems. This legislative e fort has drawn an unusually widespread support from the business d civil liberties communities. The Congress could consider t s as well as other technological-related legislation as re uiring basic determinations of how best to achieve, protect, advance privacy protections.

* *Priv te Sector*. The private sector could be provided with basi privacy standards which would assist them in determining what tivities are legally appropriate. At this time, worker monit ing has developed without the Congress having voiced its opinion on whether, how, and under what circumstances monitoring is al wable, either for Government or as private sector employees. he Congress could even investigate the needs for a new worker's ill of rights. [M. Flics, "Comment- Employee Privacy Rights: A roposal, *Fordham Law Review*, Vol 47] At the same time, private mployers might be encouraged by the Congress to establish certa privacy policies and protections. There are codes of ethics nong certain manufacturers and vendors of monitoring techn ogy. Vendors can contractually require or prohibit certain ses. For example, the Bell Company, in providing servic -observing phone equipment to telephone companies, has re ired each subscriber to agree that they would use it solely fo quality control, training, and development

purposes and will notify employees beforehand, in writing, that they were subject to such monitoring. [Mr. William Caming, _Transcript of Proceedings_, OTA, Communications and Information Technologies Program, Advisory Panel, New Communications Technologies: Implications for Privacy and Security. Washington, DC, Oct. 4, 1985, p. 122).

PRIVACY AND SECURITY

As discussed in the body of this report, the relationships between privacy and security are complex. Information security efforts and programs are not entirely supportive of Government policies on privacy. What is necessary is for the Congress as well as other major institutions in the society to support security _and_ privacy efforts. There are several policy issues which could support this approach.

1. COORDINATING AND INTEGRATING PRIVACY AND INFORMATION SECURITY EFFORTS

Privacy and information security are often in conflict and current pressures toward increasing information security may actually decrease the present level of privacy protections. The Congress can assist in the coordination and integration of privacy and information security by:

- _Structuring Commonality of Purpose_. At present, the pressures toward information and communications technology are toward securing information, with a much lesser amount of emphasis upon protecting the privacy of information. Privacy is given a lower level of attention. The Congress can assist in increasing the important of privacy by requiring privacy tandards to be met in the same way that current Congressional and Administration efforts are requiring information security standards to be met. In particular, the Congress could contribute to privacy protections by requiring privacy efforts to be established under NSDD-145. Regardless of whether NSDD-145 will function under the present NTISSC structure or the H.R. 2889 structure, Congress can set privacy provisions for information security efforts.

* *ADP Privacy Procedures*. Congress has increasingly become involved in questions of ADP purchase and operations. A policy suggestion made in an earlier contractor report to OTA [Sherizen] for a security impact statement requirement prior to he purchase or major enhancement of an ADP system is applicable for privacy as well. The Congress could consider requiring a privacy impact statement which would need to be written as an indication of the impact of technical changes or programatic operations on privacy. This impact statement would need to be reviewed by relevant management and would stand as a statement of record concerning privacy considerations which affected programatic efforts and agency attempts to protect privacy upon notification of potential problems.

2. SUPPORTING TECHNICAL DEVELOPMENTS

There are a large number of technical devices now available for information security purposes. Fewer efforts have been directed toward technical protections for privacy purposes. The

Congress might provide seed money or research support for the development of technical provisions in support of the protection of privacy. Several security developments which could also be used for privacy purposes might well be available in the near future, as has been discussed in this report. Making privacy an explicit and Congressionally important consideration will be important in integrating privacy within the development of these technical approaches.

Summary

Technology should be viewed as neither the enemy nor the solution. Although its initial development will usually be focused around the goals of only one interest group, technologies can be developed and applied with an eye to how they might be used to protect privacy and security as well as to serve broad societal ends, rather than only the interests of a special groups.

The Congress can become more involved in focusing the development of technologies in support of privacy. More specifically, there are Congressional activities which could provide some balance between the extremes of letting technological worker monitoring occur in a laissez faire fashion and attempts to prohibit all forms of worker monitoring. Interest groups of course disagree about where (and even if) a line should be drawn. Yet Congress can support what our legal system and culture suggests-- that when monitoring is done, to the extent possible it should occur in an appropriate fashion.

In that regard, the Congress can become instrumental in establishing protections against improper monitoring, establishing standards for monitoring, supporting research on monitoring, reviewing privacy protections, establishing mechanisms for privacy protections, coordinating and integrating privacy and information security, and supporting the development of technical protections.

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Additional Documents for:

Social Aspects of Changes in Worker Monitoring and Computer/Communications Privacy and Security Practices

DOCUMENT A: SOME FURTHER OBSERVATIONS ON WORK MONITORING AND PRIVACY

DOCUMENT B: WORKER ATTITUDES

DOCUMENT C: AN EXAMPLE OF A WORK MONITORING REPORT EVALUATING DIRECTORY ASSISTANCE TELEPHONE OPERATORS

DOCUMENT D: SUMMARY AND DEFINITIONS OF CERTAIN CONCEPTS USED IN THE DRAFT REPORT

DOCUMENT E: CHANGES IN PRIVACY-RELATED TERMS AS REFLECTED IN SUBJECT HEADINGS USED IN THE DICTIONARY CATALOGS OF THE LIBRARY OF CONGRESS (1966-1980)

DOCUMENT F: BIBLIOGRAPHY

DOCUMENT A

SOME FURTHER OBSERVATIONS ON WORK MONITORING AND PRIVACY

It is particularly appropriate to consider privacy related issues and technology in this upcoming year of the reintroduction of the Statue of Liberty and the celebration of the 200th anniversary of the Constitution. These remarks should be read in conjunction with the policy recommendations section of the draft report.

Privacy has tended to be reacted to, i.e., it becomes a legislative issue _after_ a crisis or public scandal. The last time that Congress passed major privacy legislation was in the mid-1970s. This was partly in response to declining public faith in government. Must the citizenry undergo another crisis before Congress responds? Unfortunately, this time Congressional action will be much more difficult than in the mid-1970, when the technology was barely in place and organizations were much less dependent upon it.

The technological capability to affect, invade, lessen or in some other fashion negate privacy protections has increased. Our society is increasingly dependent upon information processing requirements. There are relatively few institutional, legal, or even technological constraints upon increased use of work monitoring. Pressures for increasing the collection and analysis of personal information stem not only from the anti-terrorism efforts and drug testing concerns of the Government but cost effectiveness and productivity efforts in the private sector.

The lack of adequate legal safeguards for the protection of privacy mean that privacy will operate in a basic laissez-faire climate. What is very clear from our study is that there is a major potential for work monitoring to be used in ways detrimental to individual privacy. Work monitoring techniques allow for a wide range of worker activities to be reviewed, ranging from those activities which are directly related to production and security of assets to activities related to life style, and political and union involvements. Decisions on how, when, and which activities will be monitored are often made by lower level managers rather than as part of a general agency or corporate policy. Due to its ease of application and the ways by which monitoring can be used as a substitute for other traditional forms of managerial supervision, work monitoring has been and will increasingly be used by corporations and Government. These organizations have grown in power, while individuals in many ways have lost power. ? is it that workers have lost power or simply not gained?

Work monitoring is symbolic of emerging privacy problems. There is a definite need for work monitoring to curb theft, minimize possibilities of spying, and to increase productivity. On the other hand, there is also a definite need to put limits on work monitoring and to protect employee privacy.

Is work monitoring really so different from traditional forms of reviewing employee activities in earlier eras? Yes, for it allows the collection of more intensive, intrusive, timely, and wide-ranging data than ever before. Individual bits of information about an individual can be collected and rearranged into new social facts, covering a large part of one's life in a dossier which is not open to independent review or evaluation. Managerial interpretations of supposedly "scientific" information continues to be highly important. Measurement and evaluation difficulties may get lost in interpretations of this information. Important decisions about individual employees become part of an automated approach to controlling processes, materials as well as labor. Information about a worker, including that which may have little to do with their actual work performance (life style, political involvements, union orientations), can be more easily discovered, subjecting individuals to new forms of searches. Employees often learn to expect this intrusiveness as a condition of work and potentially as a condition of citizenship. To object to work monitoring is to run the risk of standing out, of being considered as against progress, cost savings, and basic managerial rights. To accept work monitoring often means that one has to accept the stress of feeling naked before invisible inspectors who are able to choose what information is important, when it will be collected, and how it will be used.

Ironically, at a time when productivity has become a national emergency, work monitoring may interfere with labor-management cooperation, lessening the very productivity gains that is one of monitoring's main objectives.

The topic has received little research attention. The limited expert attention as well as the intangibility of work monitoring activities was revealed by the high level of interest, but the low level of specific knowledge on the part of the "experts" interviewed for this project. There has been little research on the topic. In essence, work monitoring is minimally researched phenomena, despite the fact that it is increasingly being discussed in the mass media and among interested groups such as unions and women's groups as a privacy-related issue.

If the Congress accepts the challenge to examine work monitoring and its privacy-related implications, the following should be considered:

1. There are difficulties in creating legal rules which are neither too general to apply to current technologies, nor too specific to apply to future technologies. Old laws and new technology will have to be addressed, raising questions on the importance of information, data flow restrictions, definitions of overly intrusive means of personal inspection, managerial rights and responsibilities, and basic procedural processes. These and other issues will potentially create vast new challenges for our legal system.

2. The lack of current consensus on privacy standards, definitions or even basic concepts creates serious limitations on how the Congress can best address privacy protection. Many of the terms used and the assumptions built into perspectives on the problem suffer from a lack of appreciation of technological complexities, social implications, and/or legal structures. Achieving greater consensus on minimal standards required for

privacy, or a privacy bill of rights, would provide the public with a greater understanding of the centrality of privacy to the American value system and serve to inform institutions of acceptable forms of review.

3. Privacy is similar to the intellectual property issue which OTA recently studied. Both privacy and intellectual property are concepts which have been seriously challenged by technology. Congress must help establish new rules for the information age. In the intellectual property context, that answer will have implications for how ideas, property, and profits develop. In the work monitoring context, Congress' response will have a major impact on the historical battle to maintain a balance between individual and organizational power.

4. There is a need to create baseline measures which will allow monitoring to function within a context which follows central societal values. Work monitoring functions without the benefit of specific guidelines. There is a need to structure it in order to allow appropriate uses and to prohibit inappropriate uses. Work monitoring should not be the technological choice of first resort or a procedure which is established simply because the technology allows its use.

5. Technology can be used to protect privacy and to overcome or neutralize technological restrictions on privacy. Such products could be socially useful. However, this will occur only if these products were profitable, mandated, and/or funded by Government. Privacy protection is as yet a minimal consideration in technological development, requiring more

attention on the part of vendors, users, and the Government. This will be no easy task to accomplish but efforts to increase the security of systems suggests that Government will have to be an important partner if such development is to occur.

6. Congress needs an early warning system in order to better respond to the social implications of technology. This would allow Congress to anticiapte, rather than having always to reart. Technological advances will continue. The media plays an important role in publicizing new issues and in stimulating Congressional committees to make specific requests to OTA for reports and analysis.

7. Efforts toward increasing the security of systems will not necessarily improve the privacy of data. There is reason to suspect than many of the pressures now leading to increased information security in the Federal Government (NSDD-145 and anti-terrorist activities) as well as the private sector (liability concerns, severe market competition, and availability of competitive business data) could in fact lessen ~~diminishing of~~ existing privacy protections. Congress will have to find explicit ways to require both privacy and security. In order to be successful, there will be a need to establish mechanisms for review of activities as well as products which support such activities.

8. There are limits to the creation of legal rules that can reflect all of the contingencies existing in operating agencies. Creating universalistic rules to limit the ways by which agencies can treat private information will affect the ability of managers to use appropriate discretion when faced with

unique instances or cases. On the other hand, increasing the ability of managers to use discretion to create privacy protections will also create differing definitions of appropriate privacy standards.

Work monitoring has implications for privacy and security. It is a highly symbolic issue with ramifications for how private, productive, and protected this society will become. The issues around work monitoring will not go away but will continue to grow in importance and complexity. Congressional thought and action is required in order to maximize the uses of technology while minimizing social disruption and danger to important social values. How Congress responds to work monitoring will have an impact on ~~of~~ other technologically-related issues sure to come before it for consideration in the near future. Careful consideration of work monitoring can thus serve to place Congress directly in the center of harnessing and improving the advances of technology, while serving to protect citizen rights and interests.

DOCUMENT B: WORKER ATTITUDES

We reviewed major survey research studies on attitudes toward information technology and privacy in the hope of being able to use quantitative data to describe worker attitudes toward monitoring now and in the past. The studies reviewed include those by McClosky and Brill, 1983, Lipset and Schneider, 1983, Westin, 1984, Southern New England Telephone, 1984, Dutton and Meadow, 1985.

Unfortunately we found little on the question of attitudes toward work monitoring as such. The 1984 SNET study found 55% of the public agreeing with the statement "Computers can make human robots out of workers by controllng every minute of their day". In 1979 one poll found that 66% of those questioned believed "...that closed circuit tv to check on worker performance should be forbidded". About six persons in ten were opposed to lie detector tests as part of the job application process. (Dutton and Meadow, 1985)

The survey data has tended to focus on general attitudes involving the information practices of government and business toward citizens and clients, and not on the behavior of employers relative to employees (although there have been a few questions about personnel files). The relevant questions have simply not been asked. There is thus no good trend data, nor have available results usually been broken down by occupational setting. Drawing from the studies we reviewed, any systematic description would have to be general and refer to broad attitudes toward technology, information processing, privacy and civil liberties.

An increasing amount of data does suggest that the public in general is more concerned about privacy questions than in the past. But privacy invasions are not seen as a major problem by most people. The public views technological developments with a degree of ambivalence. People seem to want both the advantages that information technology can offer and to protect privacy. While support for traditonal civil liberties has clearly been increasing, there is also indifference or a lack of knowledge about many of the new potential threats to privacy. People also in general want the advantages that technology is perceived to bring. In a sense the public can be said to want it all and issues are generally not perceived to involve hard choices.

Turning to a more qualitative perpspective, from media accounts and the interviews that we conducted with managers, labor activists and academic specialists, worker monitoring per is not a salient issue for most people. There is a lack of consciousness of rights and many practices that privacy specialists find questionable seem to find acceptance, or at least toleration. Many of the more extreme practices are currently found in a small percentage of workplaces. Even within those settings where monitoring could be much more extensive (e.g. information processing organizations), it does not yet appear to be the norm (Westin 1984).

Work monitoring is one part of a broader quality of work life issue. This involves job satisfaction and control over the pace of work. For most people the privacy components per se do not seem to be clearly differentiated from the more general question.

While there are of course many differences and shades of opinion, our inquiry suggests that most workers view monitoring as an acceptable, if not loved feature of the work environment. We should also note however that the survey data suggests that general concern over privacy is greater among skilled and unskilled laborers and clerical workers, than it is among managers, proprietors and professionals. Yet the key issue is not the idea of monitoring (which as we note in the main report has considerable cultural support), but how it is done. If monitoring is perceived to be done fairly and appropriately (e.g. notice given, right to challenge or question its validity, limits on how monitoring is done and on extreme intrusiveness and on sharing the information, adequate protections for confidentiality, reliability, clear relevance to the work task, and used to help people improve their performance rather than to punish them or speed up the work) it does not appear to be something most workers challenge. (see pp. 60- 75 of the main report for additional considerations) On the other hand job stress and the physiological and psychological problems that may accompany it appear to be related to work settings where there is high psychological demand and a low degree of control over the work environment. (Karasek, 9 to 5, Ota Office Automation Study)

Our review has made clear the need for research that will focus explicitly on issues of work monitoring. The fact there has been so little research is revealing in and of itself, and points up a major need. Many of the specific practices that are now emerging are simply too new to have become a part of public consciousness. If we are to effectively deal with the questions raised by the new technologies we clearly need systematic data on their distribution and on attitudes toward, and experiences with them.

DOCUMENT C

AN EXAMPLE OF A WORK MONITORING REPORT

EVALUATING DIRECTORY ASSISTANCE TELEPHONE OPERATORS

The following report summarizes the type of monitoring which is performed on directory assistance telephone operators. It is provided as an example of the details possible with monitoring devices and the uses to which monitoring can apply. While this review is of telephone operators, it could quite easily be established for other type of workers.

For every second that the total phone system can save, there is a high dollar value which can be achieved. The phone system is highly automated and performance monitoring is used to review equipment, programs, and labor costs. Directory assistance operators are only one of the labor areas where monitoring is applied as a tool to achieve lower costs.

The chart to follow is based upon an actual performance report of a directory assistance operator. The operator who provided the authors with this report expressed amazement with the amount of work detail monitored. The answers received to this operator's request for information on the meaning of the terms found in the report were different and often contradictory definitions, often by supervisors who supposedly were involved in using these reports for reviewing the performance of operators. At times, there was no one in the office who knew what a particular term meant, how it was collected, or how it could be used to evaluate workers. The high specificity of the measurements and the differing uses which could be applied to the data indicate the vagaries of interpretation. Managerial discretion was essential in determining whether the data were to be properly or improperly used. The "facts did not speak for themselves" but required the types of human interpretation which were fraught with great potential for misinterpretation or misuse.

The following measures were found in the report. Each is defined as carefully as possible, with an attempt to clarify the contradictory information.

TYPE OF CALLS. This is the summary of the types of calls, which are the categories into which the calls, and the degrees of difficulty related to each, can be placed by the operator. **RES** is a residential call, **BUS** is a business call, **GOV** is a Government call, and **MISC** are miscellaneous calls such as time or area codes requests.

NUMBER OF CALLS. This is a listing of how many calls fall into each of these categories.

START OF CALLS. How many seconds after the call was received by the operator until the first key was pressed by the operator to start a computerized search for directory information.

RESPONSE TIME. How long the computer took to complete the search and produce the screen with information after the operator pressed the first key. This also measures the clarity and specificity of the operator's search instructions to the computer.

REPORT TIME. How many seconds it took to hit the mechanical voice button reporting phone information sought by customer, thereby completing the service response. This is a measure of the time needed from finding the information requested to pushing the button. It is sometimes used as an indicator that an operator is "oversuggesting" choices and not making appropriate directory decisions for the customer.

S/R. This is a search ratio, which is the extent of the operator's searching pattern. The higher the S/R, the more the indication that the operator searches too long for numbers.

AWT. Average work time per call, with individual operator compared to the rest of the office.

%AWT. It is the total of office work volume by the number of people in that office. On a 100 scale of all other operators in the office, the higher the number, the less time an individual operator uses for treating calls. This is sometimes considered as a key indicator of operator work measurement.

BOARD HOURS. How long an operator was plugged into the board and therefore able to receive calls. This is broken down into **LOG-IN, PLUG-IN, PLUG-OUT, AND TERMINAL LOCATOR NUMBER**, accounting for every moment on the system.

% OCCUPIED. A tool to measure work efficiency. This is the percentage of the time plugged into the system that an operator is occupied with customers. It excludes break time and other periods off of the system.

INITIAL SEARCH. This is how many calls the operator was able to handle with the initial information given by customer before having to turn to a **SBSQT-SEARCH**, which is the operator keying in more information after the initial request from the customer.

INIT-KEYING. This is the **TIME** (time) and **STRKS** (the number of key strokes) which had to be used to process calls.

LVL1 LVL2. Level 1 and Level 2, which are degrees to which information on a phone inquiry is given by the operator after the customer makes the request. A Level 2 request indicates that more than a simple request had to be entered into the computer.

SVCAT. This is when an operator is not able to handle a request from a customer and has to turn to a supervisor for assistance.

The report to follow is one-day's total report, which summarizes the information from each half hour's production data. Detailed information is also available to operators on each half hour of their work activities.

DETAILS FOUND IN A WORK MONITORING REPORT OF A DIRECTORY ASSISTANCE OPERATOR

TYPE	INITIAL			SUBSEQUENT			REPORT		S/R	AWT	%AWT
	CALLS	START	RESP	CALLS	START	RESP	COUNT	TIME			
RES	...	...	...	...	...	...	...	...	...	...	...
BUS	...	...	...	...	...	...	...	...	...	...	...
GOV	...	...	...	...	...	...	...	...	...	...	...
MISC	...	...	...	...	...	...	...	...	...	...	...
TOTAL	...	...	...	...	...	...	...	...	...	...	...

BOARD HRS ... % OCCUPIED ...

LOG-IN ....
PLUG-IN ....
PLUG-OUT ....
TERMINAL

INIT-SEARCH		SBSQT-SEARCH		INIT-KEYING		SBSQT-KEYING		SVCAT
LVL1	LVL2	LVL1	LVL2	TIME	STRKS	TIME	STRKS	CALLS

Generally speaking, this information is available to the operator upon request as well as the immediate supervisor and is understood by employees as only being used as a tool for measurement for work productivity rather than serving as a means of punishing employees. If the operator meets the standards of the supervisor, they may never ask for this data or supervisors will not use it. It is used if an operator does not meet the appropriate measures and is supposed to be used for improvement purposes only. But operators know that this measurement is always being compiled and this knowledge leads operators to feel that they have to constantly be responsible for meeting the company standards. This often leads to stress, particularly for those not meeting the standards, although this report is not a measure of how much effort they are putting into their work. It also leads to resentment on the part of some employees, especially since an individual operator is compared to the office levels, with some offices having high AWT and other offices having lower AWT. The individual operator being monitored is measured as high or low depending not only on their own individual productivity but also in comparison to their office averages.

DOCUMENT D

SUMMARY AND DEFINITIONS OF CERTAIN CONCEPTS USED IN THE DRAFT REPORT

TOTAL INSTITUTIONS.

Total institutions was used in our draft report to envision one of the scenarios. The concept is sociological, most associated with the work of Erving Goffman. Total institutions are the contexts within which people have been partially or wholly isolated from their previous background. Control is structured in an environment where people are confined for a set period, where they are cut off from the rest of society, and where they are under the absolute control of a hierarchy of officials. Examples of total institutions are an army boot camp, a naval vessel, a prison, a mental asylum, and a traditional boarding school. In each case, the individual experiences an abrupt break with their former existence and frames of reference, surrendering control over much of their lives to others who have official power. They have to follow rigid rules and they are under great pressure to conform to the values and regulations of their new environment. They have lost their personal identity and liberty, becoming resocialized to the rules and values of those in control. It is a life without privacy, where inspection and monitoring is constant. Infractions of rules are swiftly found and dealt with.

SOCIAL CONTROL

Social control was used in our draft report to discuss the ways by which work monitoring could affect employees. This is a sociological and criminological concept, focusing on the control mechanisms, techniques, and strategies for regulation human behavior. There are many public as well as private institutions and formal as well a informal ways that social control functions. The law, the family, religion, and the marketplace are some examples of ways by which people gain an understanding of what are acceptable or unacceptable behaviors and activities. There are some social scientists who are suggesting that social control has expanded in contemporary society, both in form as well as function. This dispersal of social control often relies upon surveillance of whole categories of people. Researchers have pointed out that private or corporate security has moved in a direction to control the opportunities that permit breaches of order or deviance to occur. Crime control processes become functionally embedded in structures, where those being controlled often cooperate with the controllers without an awareness that control is happening or that there are other choices available for the individual. Thus, surveillance and control is not the blatant control of the Orwellian State. It is a more subtle control, less visible in form, and more wide-spread than is easily evident. In many ways, work monitoring has the potential to serve as one of the newest manifestations of the newer social control approach.

CONNECTIONS BETWEEN SECURITY AND WORK MONITORING

At the start of the project, we had raised questions about why information security topics were part of the work monitoring project. We felt that there were very limited relationships between the issues and that they would most clearly be addressed as separate topics. All of us agreed on that approach and our draft was written in that fashion.

While we agree with Jim's comment in his letter of May 5 that there are some relationships between security and work monitoring, those connections are somewhat limited. Work monitoring does require increased security over the data collected. These data are sensitive as well as proprietary, with serious implications for employees as well as organizations if unauthorized changes or distribution occur. It is our strong suspicion that no more security is provided over these data than occur over similar data in the system. Privacy is not necessarily a consideration in the protection level assigned to these data. When these data are considered as highly sensitive and given increased protection, this is due to their proprietary rather than their privacy implications. In this sense, the adequacy of system security may only be sufficient when other, non-privacy considerations are brought to bear within an organization.

Jim's other point concerns EDP auditing as a form of work monitoring. EDP auditing and information security surveillance can be viewed as forms of work monitoring but these activities only relate to a limited aspect of work monitoring as that term is used in the project. EDP auditing, and to a lesser degree information security, have become accepted intrusions in the workplace. They are considered as necessary and appropriate activities which affect individual privacy but in structured and legitimated fashion. EDP auditing and information security surveillance are considered as cost review and crime prevention efforts. They are part of quite specific and limited objectives established by specialized personnel. Work monitoring of the sort discussed in the project tends to be more production-based, often established and reviewed by general management. There appears to be little integration of the EDP auditing, information security, and the more general work monitoring programs. While this can change in the future, there are major turf and specialization differences which will make that difficult to successfully create.

All of this suggests that to attempt to tie information security too closely to the work monitoring issue may not work and take away from their separate importances.

DOCUMENT E

CHANGES IN PRIVACY-RELATED TERMS AS REFLECTED IN SUBJECT HEADINGS USED IN THE DICTIONARY CATALOGS OF THE LIBRARY OF CONGRESS (1966-1980)

PRIVACY

1966

Privacy, Right of

See also Confidential Communications
Eavesdropping
Hamsocn
Letters
Names, Personal-Law
Portraits-Law
Right of Privacy
Libel and Slander
Press Law
Secrecy (Law)

1975

Privacy, Right of

See also Confidential Communications
Eavesdropping
Hamsocn
Letters
Names, Personal-Law
Portraits-Law
Secrecy (Law)
Invasion of Privacy
Rights of Privacy
Libel and Slander
Personality (Law)
Press Law
Secrecy (Law)
Privacy, Right of (Jewish Law)

1980

Privacy, Right of

See also Archives-Access Control
Computer Crimes
Computers-Access Control

Confidential Communications
Confidential Communications-Third Parties
Diaries in Criminal Evidence
Eavesdropping
Hamsocn
Letters
Names, Personal-Law
Portraits-Law and Legislation
Public Records-Access Control
Secrecy (Law)
Invasion of Privacy
Right of Privacy
Computer Crimes
Libel and Slander
Personality (Law)
Press Law
Secrecy (Law)
Privacy, Right of (Jewish Law)

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PSYCHOPHYSIOLOGICAL MONITORING:
POSSIBILITIES AND PROSPECTS

This document was prepared for the OTA assessment, The Electronic Supervisor: New Technology, New Tensions, September 1987.

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This document was prepared by an outside contractor as an input to an ongoing OTA assessment. It does not necessarily reflect the analytical findings of OTA, the Advisory Panel, or the Technology Assessment Board.

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1.0 INTRODUCTION

1.1 The use of psychophysiology in monitoring

1.1.1 The principal theme of the report

This report will describe for the present, near, and long term (10-20 years) the evolving capabilities for monitoring and interpreting psychophysiological signals and in particular the Event Related Brain Potential (ERP) with particular emphasis on such ERP components as the P300. Of special interest are the theoretical capabilities and constraints that will determine the utility of this field of science as the foundation for monitoring and inferring conclusions concerning office workers and workers in comparable environments.

1.1.2 Motivation for the report

Both technological and theoretical developments have greatly amplified the potential for, and the interest in, the use of psychophysiological signals as a means for monitoring cognitive and affective processes and responses in humans. Such monitoring is not novel. Inferences from psychophysiological signals are a routine matter in daily life. Whenever a companion's blush leads one to take one action rather than another a psychophysiological signal is used to monitor a human mind. The blush is an externally observed response of a bodily system and we know that there is a relatively stable relationship between a person's state of mind and the appearance and intensity of the blush. The use of the blush in this manner illustrates well the paradigm characterizing all the monitoring discussed in this report. It involves:

a. A means for making external observations on the activity of a bodily system.

b. A knowledge base that informs us about the relationship between the bodily system and cognitive and affective processes and responses. (This knowledge base may include statements that describe empirically determined correlations, e.g. "People blush when they are embarrassed." The knowledge base may be more theoretical, e.g. "Embarrassment causes system X to lead gland Y to secrete hormone Z. This hormone causes vasodilation.")

c. There exist rules, derived from the knowledge base, that allow inferences regarding psychological entities from observations of physiological function.

1.2 Factors that increased the power of monitoring

The power of this paradigm has been much amplified by the following developments:

The detection of the activity of bodily systems depends on the availability of systems that can be used to detect and record the signals.

This requires:

a. Sensitive transducers for transforming the chemical or the physical manifestations of the activity of bodily organs into electrical signals that can be recorded and analyzed.

b. A highly reliable signal conditioning and recording system whose noise level is lower than the necessary resolution of the signals.

c. Data acquisition and processing systems that can analyze in real time large masses of data.

d. A development of psychological theory that could supply the concepts and tools necessary to provide the psychophysiologist with a source of constructs and models.

e. Reliable observations on the empirical relationships between psychological and physiological observations.

f. A development of the theory, and the empirical observation, of the biological systems under observation.

It turns out that all of these conditions have been met by technological advances in the last couple of decades. These have increased the sensitivity of transducers and made it possible to record a much broader range of signals. This in turn has led to a tremendous expansion in the repertoire of measures available to the Psychophysiologist. The explosive development of Cognitive Psychology and of Neuroscience provided extended and very useful conceptual foundations for the field as well as a large body of data that can be integrated with the Psychophysiological data.

Thus, the range of phenomena that can be monitored and the strength of the inferences they permit is large and increasing. These capabilities focused the attention of developers on the possible applications of these monitoring technologies in a wide variety of domains. Applications range from the traditional use of Psychophysiology in clinical diagnosis through needs for monitoring that arise in various commercial and governmental domains. The most extensive application of ERPs has been made in medical diagnosis in particular in the assessment of sensory function (Halliday, 1982). A procedure that has assumed the status of a standard medical test utilizes ERPs with very short latencies known as the Brain Stem Evoked Potentials. These ERPs appear within 3-5 milliseconds of the occurrence of an auditory stimulus and they last for about 5 msec. It turns out that the appearance of these waves in a sequence and with timing that deviates from the normal is an excellent indication that the brain stem has been somehow damaged (Bodis-Wolner, 1982).

Medical applications are being developed also in more cognitive domains. These, however, are not yet in widespread use. It has been reported, for example, that a particular brain response (the P300) is markedly slowed in people sufferng Senile Dementia (Goodin, Squires and Starr, 1978). This prolongation may serve to distinguish patients suffering from depression from those who are senile. The literature on this application is of many opinions, (for a review see Donchin, Miller and Farwell, in press). However, it is likely that several such applications will emerge in the next decade (a review of the applications of ERPs in Psychiatric research is available in Pritchard, 1986). The main elements of these developments will be:

a. An expanding understanding of the neuroanatomical origin of the components is likely to emerge from studies of ERPs using indwelling electrodes in human patients (Allison, Wood, and McCarthy, 1986); from studies of ERPs in animals (Vaughan, 1982) and from studies of the neuromagnetic analog of the ERP (Okada, 1983).

b. An expanding understanding of the functional significance of the potentials is developing as studies of the ERP are conducted with increasing attention to theories and models of cognitive psychology. (Hillyard and Kutas, 1983; Galliard and Ritter, 1983; Donchin, 1984)

c. The decreasing costs of computing power and the increasing sophistication of graphic displays is making it possible for investigators to utilize much larger data bases than were possible in the immediate past. Thus, the study of multiple electrodes and the analysis and display of two, and even three dimensional, data patterns greatly increase the power of the analyses (see for example Morstyn, Duffy and McCarley, 1983).

Of course, the above examples derive from only one of the many psychophysiological techniques currently under intensive developments. The application of blood flow measurements, Magnetic Resonance Imagery and similar approaches allow a determination in vivo of patterns of brain activity with an increasing spatial and temporal resolution. All of these techniques share the property that they provide information on the degree to which a subset of brain regions is active at any given time. The activation is measured by assuring, using chemical labeling techniques, that brain activity would be manifested through the skull because the chemical, or the biophysical, label is detectable by extra cranial probes. These data are often analyzed by the methods of tomography to provide three dimensional images of considerable resolution. While currently available techniques have a temporal resolution measured in seconds it is likely that over the next decade the resolution will be improved substantially.

As will be seen below, the range of applications extends beyond medical diagnosis and monitoring. The applications in the area of Engineering Psychology, for example, are beginning to move from the laboratory to field testing. Thus, AFAMRL awarded in the early 80ies a substantial contract to the General Dynamics Corporation to test the feasibility of a Psychophysiological Battery developed at the Cognitive Psychophysiological Laboratory at the University of Illinois for the measurement of Mental Workload (See Heffley et al 1985; Otto et al, 1985; Gopher and Donchin, in press). The technological developments greatly reduced the cost and simplified the operation of the psychophysiological recording equipment. With the wide availability of such devices it is easy to see how they may get into hands less responsible than those found in the laboratory. The potential for abuse is substantial.

1.2.1 Plan of the report

This report will provide an overview of currently available Psychophysiological monitoring techniques. The general principles underlying these procedures will be sketched and illustrated, largely by reference to Interrogative Polygraphy, commonly known as Lie Detection, an unfortunate misnomer. We shall then focus on one class of Psychophysiological signals: the Event Related Brain Potentials (ERP). These will be introduced and their scope and range will be enumerated. The utility of one such component in monitoring studies will be described and future trends will be assessed. A discussion of the potential for commercialization, that would lack scientific basis, will be considered.

2.0 AN ILLUSTRATION OF PSYCHOPHYSIOLOGICAL MONITORING: "LIE DETECTION."

2.0.1 An overview of traditional polygraphy

It is useful to dwell briefly on one of the most common domains in which Psychophysiological signals are used for monitoring. This is the domain of "Lie Detection." Or, as we shall call it here, Interrogative Polygraphy (IP). All current approaches to IP are based on the assumption that a deceptive action on the part of the subject will be accompanied by an affective (i.e., emotional) reaction. The term "affective" rather than "emotional" will be used here because the term "emotion" is often used to include the perceived component of the reaction. However, subjects may react affectively to a situation without necessarily being aware of the fact. In other words, it is possible to react affectively without a concomitant emotional reaction . This reaction, in turn, is associated with activity in the Autonomic Nervous System (ANS, an activity that is manifested by an ensemble of actions generated within a variety of effectors driven by the ANS). Some of these actions can be detected by monitoring several organs whose activity is modulated by the ANS. The most commonly used ANS driven responses used in IP are the acceleration, or deceleration, of the heart rate; changes in the depth and the rate of respiration and the activity of sweat glands as manifested by the "Galvanic Skin Response."

The "Lie Detector" is a polygraph that is used to monitor these three responses. The Interrogator presents the subject with a sequence of events (words, questions, sentences, pictures and such like) and the degree to which an event elicits a response in one, or all, of the monitored responses is recorded. The pattern of ANS activity is then used to determine which, if any, of the stimuli elicited a supra threshold affective response. Different investigators tend to use different thresholds in detecting a response. There are also substantial differences in the method for developing and presenting the stimuli. However, in the main we can ignore these details and view the standard, ANS based, IP as an attempt to determine if the critical items do, or do not, elicit an affective response from the subject. In the more common technique the affective response to the items regarding which deception is under investigation are compared to the response to "control" items. The control items are questions that are not relevant to the subject of the investigation but which are likely to elicit an affective reaction. A question like "have you ever masturbated?" may serve as such a control question as it is assumed to elicit a defensive reaction in all subjects.

2.0.2 The character of Psychophysiological Monitoring

The nature of IP illustrates well some of the critical aspects of Polygraphy which must be kept in mind in assessing all forms of monitoring discussed in this report. The most important point is that the instrument used by the Polygrapher does not provide for the direct observation of a psychological process. Rather, the instrument measures a variety of organismic variables. The relationship to psychological variables is inferential and its validity is not assured by the reliability and validity with which the physiological functions are measured. The technical propriety of the measurement is a necessary but not a sufficient condition for the psychological validity of the measures.

A critical element in the interpretation of these measurements in the psychological domain is the situation in which the measurements are made. Any stimulus presented to the subjects is interpreted by that subject within the framework of the perceived situation and the ensemble of memories, expectations, and attitudes that are brought into the measurement environment. These psychological factors are inextricable from the technological aspects of the measurement. It is important to understand, in evaluating the technology, that its success does not depend solely on technological factors. The effectiveness with which the test environment is set up and the subject's participation in the creation of the psychological context will be critical (See Lykken, 1981).

2.1 Difficulties Associated with ANS-Based IP

In this section we review a number of the problems presented by the application of psychophysiological measurements in IP as an illustration of psychophysiological monitoring.

2.1.1 Introduction

While the use of affective responses in the detection of deception has many advocates and the technique is widely employed by government agencies and by private practitioners, it suffers a number of inherent difficulties. In any detection procedure the utility depends in part on the ratio of False Negatives to False Positives yielded by the technique and in the behavior of this ratio as a function of changes in the decision criterion. I will ignore, in this discussion, the difficulties encountered in validating IP that derive from the paucity of independently verifiable criteria for the deceptiveness or verifiability of the subjects. This matter has been discussed in great detail by protagonists of the Polygraphy debate such as Lykken and Raskin; for an accurate and accessible review of the issues see Ekman (1985). I will also ignore, for the moment, the sensitivity of the test to the arousal level of the individual. Let me just enumerate briefly some of the features inherent in the use of affective responses as indicators of a specific emotion and as specific indicators of deception.

2.1.2 The Non-Specific Nature of ANS Activity

Perhaps most serious is the relatively non-specific nature of affective responses. This non-specificity is double-barreled. It operates at the level of defining the direction and cognitive content of the emotion and it operates at the level of manifestation of the affect via ANS activity.

The difficulty in inferring emotions from their ANS "correlates" is well known. As has been reported in many studies of IP, False Positives are often the consequence of an affective response to a question, or to the presentation of an item, for reasons that have little or nothing to do with deception. Conversely, False Negatives often result from the absence, or the low amplitude, of an ANS manifestation of an affect.

2.1.3 The Non-Affective Aspects of ANS Activity

It is also the case that only a portion of the variance in the ANS activity is driven by affective processes. The ANS is charged with the regulation of some of the most vital of the body's functions and changes in heart-rate, blood pressure, respiration or sweat gland activity reflect a variety of non-affective demands by the system for increased supply of blood, of variations in the need for oxygen and for modulations of body temperature. From the point of view of IP the ANS is quite a noisy system. The "signal," that is, the ANS activity driven by affect, may be swamped or masked by the "noise," the ANS activity that is related to the vegetative and energetic functions of the system.

The factors enumerated above are, in part, responsible for the ability of individuals to produce, or to suppress, ANS activity as their circumstances require. The susceptibility of the ANS for control using biofeedback makes it even more vulnerable to voluntary control by the subject, especially for appropriately trained individuals. Control techniques may range from the voluntary generation of affect by cognitive control to the activation of bodily parts so as to create energy needs that will be reflected in ANS responses at critical points in the interrogatory sequence.

2.1.4 The utility of psychophysiological monitoring

The discussion of the complex of problems that must be solved in order to implement an effective psychophysiological monitoring system is not intended to imply that such monitoring is without value. Quite the contrary is the case. There is a large, and increasing, array of methods that permit effective monitoring in a large number of domains. My intent is to emphasize that the application of psychophysiology to monitoring of humans will require much care.

One of the dangers presented by psychophysiological measures is that they are relatively easy to employ in a shoddy manner. The equipment is generally simple and easy to attach and its output has an air of verisimilitude that can be quite deceptive. The numbers, and the curves, project an authority to which they have a right only if employed by a psychologically sophisticated investigator. Unless the setting is right and the monitoring is conducted within very strict boundaries the output of the measuring instrument may be data, but these data certainly do not provide information. I will return to these remarks when I come to discuss the commercialization of psychophysiological measurements.

With these caveats in mind we can examine some of the monitoring procedures that have emerged over the last several years as powerful psychophysiological tools. I will begin with an enumeration of various techniques spanning the range of available monitoring procedures. I will then focus on the ERP and enumerate the variety of monitoring options provided by this particular class of measures. This will lead to a focus, as an illustration, on one of the components of the ERP, the P300.

2.2 Varieties of Psychophysiological measurements

The repertoire of bodily signals that are available for Psychophysiological measures can be classified according to the nature of the signal being monitored. A classification will be presented in this section.

2.2.1 Motions

In this class belong measures that depend on the recording of muscular movements. We exclude, of course, the general class of muscular responses that are considered overt responses (whether voluntary or involuntary). The functions monitored reflect largely unconscious, involuntary movements, though in most cases people can gain control over the measures. For example, respiration is normally a automatic process. However, people can inflate or deflate their air cavity, within certain limits, if they so wish.

a. Respiration

Measures of the changing volume of the lungs as air is inspired or expired are obtained with relative ease by encircling the chest with a pneumatic tube and monitoring changes in its state as the chest inflates or deflates. Affective reactions often involve changes in the period of the respiratory cycle and in the amplitude of the cycle. These reactions are often among those to which the Interrogative Polygrapher pays much attention. A detailed review is provided by Kaufman and Schneiderman (1986.) Their summarizing conclusion is worth quoting in full as it points to future developments in the use of this index that move it from the category of mechanical indices to that of the chemical indices.

> "Although a knowledge of pulmonary volumes and capacities during behavioral experiments can tell us a lot about relationships between breathing activities and behavior, knowledge about the consumption of O2 and the excretion of CO2 provides a more direct picture of the metabolic changes that occur during behavioral situations. Use of an ear oximeter, the Douglas bag, a servo-controlled O2 monitor or a blood gas analyzer can provide important information about the metabolic changes occurring during psychophysiological experiments. (p 120)"

b. Eye movements

The pattern of eye movements can be readily measured by placing electrodes above and below the eye (i.e. on the forehead and immediately under the lower eyelid). There has been many attempts to use the direction of the gaze as a critical dependent variable in psychological experiments. For example, McConkie and his coworkers have made extensive use of an eye tracker in the study of reading. Stark (1983) has extended his pioneering work on the control of eye movements to the study of psychopathology. Extensive work on eye movements and on blinks as dependent variables was done by John Stern and his colleagues. For a detailed review of this and related approaches to monitoring focusing on the facial musculature see Schwartz (1986).

c. Facial expressions

Paul Ekman has developed a comprehensive method for coding facial expressions in a manner that does not prejudge during the coding process the emotion that underlies the expression. Thus, rather than code expressions as "frowning," "joyous" or "threatening," the Ekman scheme describes the facial expression as a pattern of movement in the facial musculature. With this tool in hand Ekman and his colleagues studied the relation between facial expression and affect and provided a most effective set of tools. Theirs is probably the single most innovative approach to the study of the psychophysiology of affect in the latter half of this century. For a technical treatment of the subject see Ekman and Friesen (1984). For an excellent description of the application of this approach to "Lie Detection" see Ekman (1985).

d. Pupillary dilations

As Beatty (1986) notes in a detailed review of the psychophysiological value of the pupillary system "the primary use of pupillometry in psychophysiology is in the study of brain activation and arousal, (p. 43)". Pupillary diameter can be monitored relatively easily, though the analysis of the data may be rather laborious. Simply stated, mental effort appears to cause the pupil to dilate. The study of the pupil has a long and venerable history (Hess, 1975; Khaneman, 1973) and modern pupillometers allow observation of the pupillary diameter regardless of head motion and direction of gaze. Albeit that such unrestricted monitoring requires at this time fairly expensive equipment (by the standards of psychological research where an instrument costing $10,000.00 is considered pricey).

e. Plethysmography

The plethysmograph measures cardiovascular activity by monitoring the volume of the extremities, usually the finger or the earlobe. It is one of many psychophysiological measures of the heart's activity and does not require a special discussion here except as an example of the variety of mechanical means that can be used for monitoring various functions.

2.2.2 Voltages

In this class we include measures in which the recording instrument is sensitive to voltages generated within the organism as a consequence of the activity of the bodily organ.

a. Electroencephalogram - (EEG)

Voltage differences between two points on the scalp that are due to ionic flows within the brain and the fields generated as a consequence of the summation of large population of individual neurons, (see Allison, Wood and McCarthy, 1986; a very extensive analysis of the physical foundations of EEG analysis can be found in Nunez, 1981).

b. Event Related Brain Potentials - (ERP)

A subset of the EEG. The ERP represent that component of the electroencephalographic activity that is time-locked to external or internal events. It is extracted by computer analysis from conventional EEG. This class of measure is discussed in detail in section 3 of this report.

c. Electrocardiogram - (EKG)

Voltages generated in the course of action of the heart muscles. The signal is recorded by means of the standard cardiographic procedures can be analyzed for a number of parameters ranging from the global analysis of the Heart Rate to the minute examination of the wave shape of the EKG which is widely used in clinical medicine. Even though classical psychophysiology is essentially cardiovascular psychophysiology it will not be discussed in detail in this report as much material is readily available. The chapter by Larsen, Schneiderman and Pasin (1986) provides a detailed review.

d. Galvanic Skin Response - (GSR)

The common measurement associated with the GSR is actually a measure of changes of resistance rather than of voltage. However, these changes of sweat gland activity that have played an important part in the history of Psychophysiology has a voltage counterpart, discovered by Féré. For a review see Fowles (1986).

2.2.3 Other measures

In this section I will enumerate a number of additional measures that cannot be easily categorized.

a. Metabolic changes

This is probably the most exotic, and the most rapidly developing, mode of monitoring. In general the technique labels chemicals that are utilized in a brain process with a radioactive label and a computer aided monitoring system tracks the behavior of the compound over an epoch. It is possible to reconstruct from these data the progress of action in different brain structures. When subjects are engaged in various psychological activities it is possible to determine by these techniques which different brain structures are involved in a specific activity and to what extent.

It is not clear at this time with what resolution would these techniques serve as monitors of human information processing. At this time they all depend for their success on the integration of measurements taken over periods measures by seconds, or by minutes. Thus they seem more suitable for monitoring state variables rather than specific responses. However, the development in these approaches has been, and is, explosive and therefore predictions should be made with great care.

b. Magnetic measurements

The electrical activity of the brain has, of course, a magnetic counterpart. The very small amplitude of the magnetic activity delayed the development of the measure. However, in the last decade a technology based on the use of superconducting probes has developed and it allows the recording of magnetic brain activity both as continual signal analogous to the EEG, and as an evoked responses analogous to the ERP.

At present the magnetic recording requires rather expensive and cumbersome equipment. Large "Squids" must be used and a supply of liquid helium is required. At the most sophisticated it is possible to record from 14 simultaneous probes. However, a system that supports such a recording montage sells, in 1986, for around one million dollars. A number of research programs attempt to develop smaller detectors. Should these become available the obvious advantages of the magnetic recordings will greatly accelerate their use (See Beatty, et. al 1986). The most important aspect of the Magnetic Evoked Field is that it is possible to infer, with some precision, the locus of the intracranial generating source of a magnetic field from the scalp distribution of the field. That is, a map of the distribution of the strength of the magnetic field at different scalp locations provides the data necessary to identify the location of the field within the skull. It is not possible to perform the equivalent analysis using ERPs because the electrical potentials are volume conducted in the skull and the same scalp distribution can be generated by an infinity of sources.

c. Temperature changes

It is possible to sense body temperature externally. Several investigators have proposed that such changes may be useful in

Psychophysiological monitoring. However, these techniques have not been developed to any serious extent (see Schwartz, 1986)

2.3 The Psychophysiological Signal - Criteria for Monitoring

As is true of all technologies, their proper application requires careful attention to details. The purchase of a polygraph and the availability of a subject to whom the polygraph can be attached (or whose brain can be scanned by a CAT scanner) guarantees that the investigator will have curves, or pictures, to show. However, these will be of no value if they were obtained without proper attention to methodological, and logical, aspects of the recording. In evaluating monitoring techniques it is important to assure that the following criteria have been properly considered.

a. Proper methodology

The utility of the measurements depends, almost by definition, on the technical quality of the effort. It is important, however, to realize that "technical" considerations are not exclusively related to the instruments in use. Of course, one must assure that the equipment is properly maintained and adequately calibrated. The bandwidth of the recording must be broad enough to include the signal of interest. To the extent that digital analysis is involved such matters as the digitizing rate and resolution are critical.

However, attention must also be paid to the biological and the psychological adequacy of the effort. By way of example of the biological cautions that must be observed we note that the body is a source of many signals and that some signals may appear to the recording instrument in the shape and form of the signal of interest. In other words, the body itself may be a major source of measurement artifacts. Thus, movements of the eye ball that may in one context be the signal of interest have a time course and a shape that makes if very easy to take oculographic signals as if they are ERPs. It is the investigator's responsibility, whenever ERPs are the target of measurement, to ascertain that the data presented are not confounded by oculographic noise. Several techniques are available (see Gratton, Coles and Donchin, 1983) that serve this purpose and the extent to which these are used determines the value of the ERPs as a monitoring tool.

There are of course innumerable such cautions, many for each of the techniques enumerated. The relevant conclusion for this discussion is that the application of Psychophysiological monitoring is not a matter for amateurs. It is not possible now, and will probably not be possible in the future, for anyone to purchase off the shelf instruments and to use these for accurate and valid monitoring. Extensive training in the finest details of the engineering, biological and psychological aspects of the recordings is a necessary condition for such applications.

b. Construct validity

Attempts to use psychophysiological signals for the monitoring of psychological processes require that the psychological constructs used in the analysis be properly validated. That is, if one proposes that, say, blushing is correlated with "embarrassment," one is relating a physiological response that can be measured, given the precautions mentioned above, to the psychological construct "embarrassment." Evidently such a relationship can be of interest only if it has been made very clear how "embarassement" has been defined and measured and that the psychophysiological assertions undelying the assumption that measure X monitors construct Y are indeed meaningful.

c. Unambiguous psychophysiological relationships

The proper validation of the constructs is a necessary but not a sufficient condition for the success of monitoring. It is usually far from easy to establish the distinctness of such constructs. Is, for example, "embarassement" distinct from "arousal?" How does one tell when subjects are "aroused" without being embarrassed and when they are embarrassed without being "aroused?" These, of course, are very difficult questions that serve as the substance for much of psychological theory. However, they evidently lie at the heart of much of the controversy surrounding psychophysiological applications. The most widely known example being the disputes regarding the use of polygraphy in Lie Detection where the activation of ANS measures may be attributed to the operation of several psychological mechanisms only one of which, presumably, indicating that the subject has been deceptive.

d. Cost of system should not be larger than the benefit of the information

On this point not much need be said. In virtually all cases psychophysiological monitoring is expensive. Equipment is a necessary component. The more elaborate the technique the larger the data base that is generated and all the data need be stored and analyzed. There must be full access to normative data bases. Furthermore, in many of these techniques the subjects must come to a recording site where the equipment resides. Thus, the benefit of the gain in information derived from the use of the equipment must be carefully weighed against the cost of obtaining the information. No general rules can be developed as the issue need be resolved in each setting.

(Of course, as technology develops and as the demand for equipment increases, creating a substantial market, the size and the cost of the equipment may decline. Consider, for example, the wide availability in the mass market of tools for the measurement of blood pressure and heart rate as these have become a matter of personal use in the health monitoring and exercise domain, multiple units whose fields are so aligned that they summate to produce recordable potentials.)

With these criteria in mind we proceed to examine in some detail one psychophysiological index, the Event Related Brain Potential (ERP). We will describe the measure, discuss briefly the recording procedures and list some of its components, each of which can be used in monitoring. For reasons that have largely to do with the personal interests of the author we will examine in much detail one of these components, the P300.

3.0 The Event Related Brain Potential

3.0.1 An overview of the technique

The data we discuss here are obtained by placing electrodes on a person's head and recording electroencephalographic (EEG) activity while the person is engaged in a task. Using the technique of signal averaging, we then extract from the EEG (a voltage x time function) estimates of the portion of the voltage (the ERP) that is time-locked to some event of interest. We assume that these ERPs represent the synchronized activity of ensembles of neurons.

A distinction is usually made between "exogenous" components, which occur early (within the first 100 msec) and "endogenous" components, which occur later (Donchin, Ritter, & McCallum, 1978). Exogenous components reflect early neural processing of the features of the stimuli presented. They are obligatory responses to stimuli whose amplitude and latency are responsive to changes in the physical characteristics of the stimulus, and whose scalp distribution is determined by the sensory system activated. In experiments designed to investigate these early components, subjects typically lie passively while stimuli are presented, often at very high rates (10 times/sec is common in auditory paradigms).

In contrast, cognitive psychophysiological paradigms often challenge the subject with complex tasks, and the subject always has some task to perform. Several attributes of the task are manipulated and serve as the independent variables of the study. Systematic changes in brain activity measured at the scalp are considered representative of the engagement of different neural processes, and serve as the dependent variables. The complex brain response is analyzed for patterns of activity that are characterized by a distinct scalp distribution and by a consistent relation to task variables. These are defined as the endogenous components of the ERP. Such components are distinguished by the fact that they are not obligatory responses to physical stimuli; whether they will or will not be elicited depends on the nature of the information processing required of the subject.

The endogenous components that follow a warning stimulus and precede an imperative stimulus, for example, are believed to be manifestations of intracranial processes that are involved in the subject's processing of the warning stimulus and preparation for a forthcoming stimulus. Endogenous components that follow a task-relevant stimulus depend more on the processing demands imposed by the task than on the physical nature of the eliciting stimulus (Donchin, 1979, 1981). In contrast to the exogenous components, they can also occur long after the stimulus (often between 500 and 1000 msec).

Although the endogenous components of the ERP can be recorded with reliability, the source of these components is not known. Evidence has begun to accumulate that suggests that some of these components may not be generated in the cortex (Halgren, Squires, Wilson, Rohrbaugh, Babb, & Crandall, 1980; Wood, Allison, Goff, Williamson, & Spencer, 1980). There is a hint from this work that we may be observing neural activity generated, in part, from archicortex (the hippocampal formation) and/or the subcortical amygdaloid nuclear complex. Some of the more compelling data, obtained in studies of patients with indwelling electrodes, have led Wood, et. al (1980) to conclude that one endogenous component, the P300, may not reflect the activity of a unitary generator. They suggest that this component represents the summed activity of multiple sources with multiple orientations (see also Okada, Kaufman, & Williamson, 1983).

The ERPs provide a rich class of responses that may, within the appropriate research paradigm, allow the study of processes that are not readily accessible to experimental psychologists by other means. The key assumption of cognitive psychophysiology is that ERP components are manifestations at the scalp of the activity of specific intracranial processors. Our reference is not to specific neuroanatomical entities, but rather to specific functional processors. While networks of nuclei may be involved in a dynamic fashion in the activity represented by each ERP component, our current understanding of the underlying neuroanatomy is insufficient to generate meaningful neuroanatomical hypotheses. Yet, the available data, regarding the consistency with which certain components measured at the scalp behave, permit us to hypothesize that these components do signal the activation of internal "subroutines."

The discussion above should not be construed as implying that the electrical activity recorded at the scalp is itself of functional significance. For our purposes, the ERPs may be due solely to the fortuitous summation of electrical fields that surround active neurons. Although some have argued that EEG fields do have functional significance (especially persuasive is Freeman, 1975), we can remain agnostic on this issue. For our purposes, it is sufficient that we elucidate the functional role, in information-processing terms, of the subroutines manifested by the ERP components. It will, of course, be of considerable interest to obtain a detailed neurophysiological description of the neural implementation of the subroutine. However, a description of the subroutine as a processing entity is of interest independently of the neurophysiological description.

3.0.2 The benefits of ERPs in monitoring

The principal benefit that may accrue to monitoring from the introduction of ERPs into the repertoire of the investigator is the more direct contact they provide with cognitive, rather than with affective, activity. As in ANS-based IP, the investigator's task is the creation of conditions in which knowledge unique to the guilty will reveal itself by triggering a specific, and uniquely interpretable, response. The ERP responses, however, are manifestations of specific information processing activities, not of specific emotional responses to stimuli. As far as we can tell, the activation of the appropriate internal subroutines is always accompanied by the appearance of the appropriate ERP component. To the extent that the subject processes the information in a certain manner and the processing manifests itself in an ERP component, the appearance of the component tends to be obligatory. This is not to say that any ERP component is an automatic candidate to use in monitoring. However, there are some very strong indications that the technique can be of considerable utility.

3.1 The Vocabulary of ERP Components

It is important to emphasize that the P300 is not the only ERP component that can be employed in Monitoring. The ensemble of information processing activities manifested by the ERPs is already quite rich. Additional components are being discovered and deeper understanding is being reached of components which have been known since the mid-60's. In principle, almost all of these components can be utilized in monitoring.

a. N100 - Direction of Attention

Hillyard and his associates (see Hillyard and Hasen, 1986) have shown that the N100 component (recall that components are labeled as <N>egative or <P>ositive, and the number following the character refers to the modal latency of the component) is affected by the directions of the subject's attention. Events in the focus of attention tend to manifest a somewhat larger N100. The effect is reliable. It can be used to monitor changes in the directions of the attention, or changes in the attentional level. Thus, the N100 can play a role either in ascertaining if the subject is actually following instructions with regards to the allocation of attention, or to determine if events in the environment have caused the subject to shift attention. In a way, the N100 is sensitive to "affective" processes as are the ANS responses. Yet, it is likely to be less susceptible to subject-controlled actions.

b. N200 - Detection of Mismatch

Considerable evidence exists that the N200 is elicited by events that violate a subject's expectations, even if they occur entirely outside the focus of attention. Thus, the N200 seems to be a manifestation of the activation of a "mismatch" detector. This component is, it would seem, the least susceptible to control by the subject's voluntary actions. The occurrence of any deviation from regularity, indeed any mismatch between an event and its immediate predecessor, elicits an N200. Thus, with the proper setting and with adequate recording equipment it may serve as an exceptionally effective tool in monitoring (see Naataneen, 1985).

c. P300 - Updating of Working Memory

We have already referred to the P300. It may be useful to note that in addition to its amplitude, that can play a useful role in monitoring, the latency of the P300 has proven an excellent indicator of mental processing time. Since the elicitation of the P300 depends on the categorization of the events in the oddball sequence, then its latency is evidently a function of the duration of the categorization. A variety of scenarios suggest themselves for utilizing the P300 latency in IP.

d. Readiness Potential - Preparation to Respond

The Readiness Potential and the Contingent Negative Variation are among several ERP components that we call Event-Preceding Negativities (see Ritter, Kelso, Kutas, and Shiffrin, 1984). They are quite clearly related to the activation of preparatory, often unconscious, processes by the subject. In recent work we have shown that it is possible to determine, from the extent to which these potentials are larger over one hemisphere rather than the other, which response the subject was contemplating regardless of the response that has actually been made. This feature of these components makes them a very strong candidate for use in IP as they appear to provide a means for assessing conflicts that occur before a response is emitted.

e. N400 - Semantic Mismatch

Kutas, in an extensive series of studies (see Kutas, Lindamood, and Hillyard, 1986), has shown that words that are in some way incongruous, or unexpected, within a discourse elicit an ERP component that is negative and has a latency of about 400 msec. In a way this appears to be a "semantic" component that is elicited by unexpected events. However, it is uniquely associated with linguistic stimuli. Its promise in IP is substantial.

4.0 ILLUSTRATION: THE P300 AND THE ODDBALL PARADIGM

In this section we will discuss the manner in which the P300 component can be used in monitoring. As is true of all other ERP components the P300 is extracted from the ongoing EEG by signal averaging. Its measurable attributes are the amplitude, the latency and the distribution of the potentials across the scalp. These can be used in various combinations in domains as disparate as clinical neurology and human factors. However, much of the use depends on the integration of one basic paradigm, the so called "oddball" paradigm, into the monitoring situation. That paradigm will be discussed in the next section. The manner in which it is employed in a diversity of monitoring situations will then be reviewed.

4.0.1 Description of the Oddball Paradigm

The procedures for using P300 may serve as an illustration of the conceptual issues described thus far. We normally study the P300 in the context of the so-called oddball paradigm. In this procedure the subject is presented with a series of events. The critical attribute that defines a series as an oddball paradigm is that there is a classification rule that categorizes all the events in the series into two categories. The classification rule can range from the concrete to the abstract (i.e., frequency differences of tones, exemplars of two different categories). The events can be quite diverse and the categorization may depend on an ensemble of properties of the events.

Another critical attribute of the paradigm is that the events from each of the two categories are chosen at random and that one of the categories is selected much less frequently than the other. Finally, it is necessary that the subject be assigned some task that requires active processing of the events. When these conditions are satisfied, then events that belong in the rare category elicit a large P300, whose amplitude is inversely proportional to the probability of the eliciting event-category and directly proportional to the relevance of the event to the subject's task. It appears from research that we, and others, have conducted in the last 15 years, that the P300 is a manifestation of the activation of processes that are involved in the maintenance of working memory. The activation of these processes is non-conscious, except in the sense that the subject does consciously monitor the events. Furthermore, as far as we can tell, the P300 is an obligatory response to the event, if the subject is in fact processing it.

The utility of the paradigm in monitoring environments is that it provides a rather standardized measuring tool that can be easily ported from one situation to another. The following attributes of the P300 have been utilized in various models of monitoring:

a. As the P300 is commonly elicited by rare, task relevant, events it can be used to infer which events in a series to which the subject attends were perceived as being rare events. In other words the P300 can be used to determine if an event has surprised the subject.

b. The lower the probability of the event, the larger would be the P300. Thus, all things being equal, the amplitude of the P300 can be used as an estimate of subjective probability assigned by a subject to events.

c. The more attention the subject directs to a task the more likely are stimuli associated with that task to elicit a P300. These task relevant stimuli generally have to be rare to elicit a P300. However, if the subjective probability is held constant and the subject attention drifts away from stimuli the amplitude of the P300 will decline. This characteristic underlies the use of P300 in the monitoring of mental workload.

d. The latency of the P300 is proportional to mental processing time. Therefore it can be used as a means for monitoring mental timing in a manner that is not contaminated by motor activity.

4.0.2 The use of P300 in the assessment of Mental Workload

It is possible to use the P300 as a metric for Mental Workload. The technique is somewhat indirect, but it is in keeping with the general tradition of Workload measurement. We have adopted a technique called the secondary task procedure. An example may help. Suppose one is driving a car on a highway and carrying out a conversation with a companion. Driving the car is the "primary task" and the conversation is a "secondary task." (While it is perfectly possible to think of a situation in which the conversation may be more important than the driving, in our example this is not the case.) Now, as long as the traffic is light and the weather is good and one knows the way, the conversation flows naturally. It is easy to follow a companion's train of thought and one can articulate one's views with great eloquence. Then, the traffic becomes heavy; the driver is in the left lane and must pull to the right to exit on the very next exit. The driving is still smooth. There is no drop in speed. The lane change is executed in a timely and efficient manner. In other words, the performance of the primary task has been protected. But, this is done at the expense of the secondary task as is evident from the fact that the driver stopped attending to the conversation. The answers become laconic and, in the end, irrelevant.

Thus, the pressure experienced in connection with the primary task which did not reflect itself in the driving, did cause a deterioration in the performance of the secondary task. If we had some measure of secondary task performance we could determine the difficulty of the primary task by measuring the deterioration in the performance of the secondary task. The trick is to find secondary tasks that provided a usefully gradable measure of performance and which can be combined with primary tasks without affecting in turn the primary task. Research conducted primarily at the Cognitive Psychophysiological Laboratory at the University of Illinois has shown that the oddball paradigm can serve as such a secondary task and that the amplitude of P300s elicited by stimuli associated with such secondary tasks will vary inversely with the workload associated with the primary task (Donchin, Kramer, & Wickens, 1986).

4.0.3 The use of P300 at a mental prosthesis

A project currently under way at the Cognitive Psychophysiology Lab at the University of Illinois uses the P300 in a tool designed to allow a person who has lost all control of his musculature, and has no speech, to communicate words to a computer. This is achieved by converting a matrix in which 36 different items are turned into an oddball paradigm. The latter the subject is thinking is the mode to elicit a P300. Note this is an example of a technique which appears to be the ultimate in mechanical mind reading but which in effect is no more than a trick which allows the subject to turn a switch with his brain waves rather than with a finger. The key to success, as in all such monitoring, lies in the setting of the situation in which the data are acquired rather than in the data acquisition approches.

5.0 PSYCHOPHYSIOLOGICAL MONITORING AND PRIVACY

If we can indeed make such powerful inferences from the ERP, we do seem to have the capacity to "read the mind." We have on hand a psychophysiological tool that gives its user what may appear to be quite a disturbing power. The worries have indeed surfaced. Take for example a fairly lengthy article carried on June 3, 1984 by the Washington Post. The article was written by correspondent Michael Schrage and was entitled "Technology Could let Bosses Read Minds." The article continued on the following page under the headline "Privacy Veil May Block Brain Watchers View." Schrage reports that "Researchers in both Academia and industry say it is now possible to envision a marketable product that could instantaneously assess whether employees are concentrating on their jobs by analyzing their brain waves as they work..." He tells us that Westinghouse Research and Development Center in Philadelphia is "exploring the use of brain wave analysis - particularly the brain wave known as the P300 - as a means of determining the individual's level of attention and cognitive processing." A Westinghouse man is quoted as predicting that "within the next 10 years Westinghouse could market a complete system capable of monitoring the mental processing effort of employees as they worked..."

This discussion inevitably leads Schrage to discussions with legal scholars and labor leaders regarding the invasion of privacy implied by these developments. While the present report does assert the feasibility of the enterprise described by Westinghouse, I am less inclined to worry about invasion of privacy. The most likely misuse of psychophysiology will be the

Polygraphyzation of the research conducted with the ERP over the past 20 years. By Polygraphyzation I mean the adoption of scientific discoveries for commercial utilization without adequate attention to the effectiveness and utility of the procedure. Polygraphyzation occurs when the commercial development is done without an anchor in the scientific community. Actions are taken to assure the profitability of the product and caution and control become less critical. Training is minimal and tends to be highly professionalized. I emphasize that all this is done well within the law. But, it remains the case that it is quite possible to have what appears to be an impressive instrument that is essentially worthless.

5.0.1 The issues presented by the P300 data

Let us take a few minutes to consider the issues raised by the P300 data. It is clear that in laboratory conditions we can "read the mind." One can think of any number of applications for such a procedure, and few have been described above. However, if one is offered a box in which a pointer is driven to the right or to the left by the magnitude of the P300 as a function of some mental process two classes of questions arise.

There is the question of utility. Does the technique really work? How general is the utility. To date there has not been a test of the P300 based on procedures in valid ecological testing; with the exception of some of the more clinical applications. We know the procedures work well in very complex lab arrangements. Yet there has never been enough support to allow the sort of thorough experimentation in highly normative situations. This issue is, to a large extent, open.

Then there is the issue of Privacy. What is the degree to which monitoring impinges on individual rights? Does it go beyond currently accepted interpretation of the rules? The worry here must be tempered by an understanding of what the machine is actually doing. It is useful to review briefly the constraints on the machine. Also we need to distinguish between two modes of privacy invasion. The popular notion is that it will be possible to achieve the technical feat of making audible by mechanical (or electrical) means those thoughts which constitute our internal speech. Thus, the metaphor driving the worry is that of eavesdropping. But, this has never proven possible.

Eavesdropping on the mind is unlikely. It would only be possible if the signals we can record externally carry within them the richness and the variety available in mental life. One can fantasize, of course, that new technologies will increase the range of the monitoring. Indeed, given the trends in increased computing power and reduced size and cost, some super minicomputer implemented on biological principles might have the power and the savvy to interpret the signals in a depth that matches the profundity of the task. However, it is my belief, that even in that case psychophysiological eavesdropping would not be possible.

To some extent the constraints that could not be eliminated come from the fact that there is too much noise to develop a useful eavesdropping technique. There are too many processes all working in parallel and furiously interacting with each other for there to be a possibility that an external manifestation of any one of these processes will talk to a computer in the same language it talks to its counterparts in the system.

This matter of the "language of the brain" is crucial here. However thought processes are implemented, their implementation is ultimately a matter of neurons talking to neurons. Indeed, it is most likely a matter of millions of neurons talking to millions of other neurons. These neurons converse, of course, with each other by whatever language is used for such communication. There is not yet a full consensus as to the nature of that language. It is clear that in the main neurons affect other neurons by secreting tiny doses of chemicals (the "neurotransmitters"). These secretions are the consequence of the conduction of neuronal impulses across axons and the integrative activities of the dendritic membranes.

We, who study ERPs, benefit from the fact that when occurring in the mass, and in a highly synchronous manner, these inter-neuronal actions manifest themselves on the scalp in the form of large integrated fields of potentials recorded as the EEG. However, this largely epiphenomenal activity while valuable as an index for the time course and level of neuronal action is unlikely to serve as a source of information on the specific nature of the vast exchanges in the neuron's own language that have given rise to these psychophysiological signals.

Thus, it is only the second sense of monitoring that one can assume psychophysiological signals to be of use. We are not, and will not, eavesdrop on the mind. Rather we are observing the consequences of neural action and by judicious construction of the situation we may be able to pose questions to which the psychophysiological signals may give an answer. This metaphor describing psychophysiological monitoring as a process of seeking answers to specific questions is very important because it underlines the principal condition to the success of such monitoring. The value of the answer will depend on the sagacity with which the question has been put. In other words the key to the utility of these approaches is the ability to pose useful questions rather than the procurement of yet another measuring instrument.

Proper application of psychophysiological monitoring requires that one realize that what is being monitored is the activity of bodily systems. These systems are driven for physiological reasons by the demands of the system. These bodily organs serve more than one function and therefore their activity cannot be presumed to be uniquely related to any psychological construct.

The signals we record make sense, therefore, only in terms of situation. There is no "deception" wave - a wave that no matter when and under what circumstances it has been recorded indicates that the person has lied. There is not even a wave that indicates unequivocally that any emotion occurred. Rather, the change in the physical signal indicates the activation of a certain processor, or processors. If, and only if, this is uniquely interpretable within the context of the recording it is possible to make psychological inferences from the data.

Thus the degree to which psychophysiological signals can have psychological meaning depends more on the degree to which the system is set to be driven in a unique fashion by the psychological variables. For example: The workload assessment techniques employing the P300 we described above depend on the establishment of a very sensitive relationship between the conditions of measurement and the subject's ability to perceive the demands.

Unless the subject is performing the two tasks assigned in the dual task setting the measurements of the P300 have no value. Furthermore - intense validation and reliability assessment are still needed.

In other words, active participation of the subject is a condition for the success of psychophysiological monitoring. It is unlikely that it would be possible to apply an unobtrusive probe that will intrude on the subject without at some level the subject accepting the structuring of the situation that constitutes the question addressed to the psychophysiological system.

The above remarks should not be construed as casting doubt on the utility of psychophysiological monitoring. As I indicated above the increasing depth with which these signals are understood and the increasing sophistication of cognitive models when coupled with the spectacular developments in miniaturization, sensor technology and data analysis open a very broad scope for such monitoring. However, this will only be accomplished within the constraints of good methodology. Furthermore, whatever monitoring can be done will be constrained by the nature of the biological and psychological systems involved. One must steer clear of the extravagant claims, and avoid the unnecessary fears that these might invoke.

6.0 THE DANGERS OF COMMERCIALIZATION

It must be emphasized that the remarks made in this report, and in particular in section 6, pertain to the scientifically valid use of the techniques. It is a sad, but obvious, fact that the limits science and nature impose on feasibility do not always serve as constraints on the huckstering of technological pseudo-marvels. That reason, and proper scientific analysis, suggest that eavesdropping on the mind is unlikely does not, unfortunately, imply that the public or elected officials will not be persuaded that a technical miracle has been achieved by someone with a gadget and good marketing technology.

The cases are innumerable in which the gullibility of the market place has served to enrich those who peddle worthless solutions to serious problems. From Snake Oil to Water Divining to, perhaps, Strategic Defense, the public (and its elected and appointed representatives) can be induced to believe in the efficacy of some technique despite the caveats of informed scientists (who, admittedly, can also err).

Thus, this report is addressing solely the issue of the scientific feasibility and the validity of psychophysiological monitoring. Whatever conclusions we draw will not address the degree to which there is a possibility that Industry, or Government, will be induced to believe that a specific technique is indeed valid and that using it is the best one can do in a difficult situation. Under such circumstances vast systems for monitoring individuals may be implemented. That they will be of no scientific value will not reduce their social impact. However, the consideration of public decision making and the sorry interaction between the gullible and the unscrupulous, or the naive, is a matter for Sociologists or Political Scientists not Psychophsyiologists.

7.0 SUMMARY

In this report I surveyed the manner in which psychophysiological approaches may be used, at present and in the near future, to monitor individuals, with particular attention to the monitoring of affective and cognitive responses. A general survey of various indices was followed by a more detailed discussion of the use of Event Related Brain Potentials and in particular the P300 component as a tool in the study of mental functions.

It is concluded from the review that there is indeed a large and increasing potential for the use of psychophysiological techniques. However, we also note that the use of these techniques requires considerable care and that their application requires training and sophistication in the technological, biological and psychological aspects of the work. We emphasize that the monitored data can be interprted only within a detailed understanding of the context of the measurements.

We note that it is unlikely that such monitoring would allow intrusive "reading" of a person's mind. Yet, it is quite possible to arrange recording circumstances that, with the subject's cooperation, could serve to illuminate the content and form of a person's mental activity. Thus, the worries regarding the violation of privacy by such psychophysiological means are exaggerated when couched in alarmist terms, yet these worries are not to be entirely discarded.

A particular worry that rooted in the sociology of technological development rather than in psychophysiology is that a superficial application of psychophysiological findings may lead to widespread employment of devices purporting to allow monitoring. The fact that these devices are so error prone and ambigous may not affect their widespread use in a manner that would affect decisions regarding individuals' fate. The manner in which the Polygraph is used in personnel screening is a case in point. Thus, even though the real power of the techniques may be constrained and benevolent, the marriage of greed and gullibility that so often determines the action of public bodies does leave room for concern.

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